ANIMAL LIFE

DESCRIBED AND ILLUSTRATED.

BY

E. P. WRIGHT, M.D., F.L.S.,

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ANIMAL LIFE:

BEING

A Series of Descriptions

OF THE VARIOUS

SUB-KINGDOMS OF THE ANIMAL KINGDOM.

BY

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WITH ILLUSTRATIONS.

CASSELL, PETTER, GALPIN & CO.:
LONDON, PARIS & NEW YORK.

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[1879]

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"THE BEST AND PUREST OF ALL PLEASURES WHICH A MAN CAN FEEL, AND THE INEFFABLE SWEETNESS OF WHICH THE WORLD CAN NEVER REALISE, IS THAT WHICH THE PHILOSOPHER ALONE FINDS IN THE STUDY AND CONTEMPLATION OF EXISTENCE."—*Plato*, "The Republic," ix.

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GEORGE HENRY LEWES

I DEDICATE THESE PAGES,

AS A SINCERE THOUGH IMPERFECT OFFERING.

PREFACE.

In preparing the present Work it has been thought desirable to keep especially in view that large class of readers who, while they take an intelligent interest in the study of Natural History, have but little taste for the technical details which would naturally form the bulk of a scientific manual on the subject. To suit this exigency of the public demand it was decided that nearly two-thirds of the contents of this Volume should be devoted to the Mammals and Birds. The comparatively small portion which treats of the more simple forms of Animal Life is thus to be accounted for. To compile a popular story-book about animals, and at the same time in some degree to write a scientific manual, is acknowledged to be a difficult undertaking. If in a fair measure I have succeeded, it is as much as I can expect.

Where, throughout the whole of a work of this kind, one is necessarily indebted to various authorities for the facts, it is perhaps not so necessary to particularise the exact sources from which they are borrowed. Nor, indeed, would this be always possible. This book, in its present form, never would have been written were it not that it is based on the notes of several series of Lectures on Zoology, delivered some years ago to the Natural History Classes in the University of Dublin. At the time of giving these Lectures I doubtless knew well whence I had taken the illustrative notes, but not by any effort of memory could I, when writing this Volume, always call to mind their exact origin. I believe that in all cases where I have taken extracts from the writings of distinguished travellers, such as Darwin, Palgrave, Bates, Wallace, Livingstone, Tennant, Hooker, Cunningham, &c., they will be found referred to their respective sources, but I am anxious thus generally to apologise for not being as accurate in giving the references for all my other quotations as I would have wished.

The statistics for the census of the species of Birds and Reptiles belonging to each family are based upon those in Wallace's invaluable work on the "Geographical Distribution of Animals."

Had space permitted it, I would gladly have given at least the names of every known Order in the Animal Kingdom, and I should have liked to have treated of each at about the same length as I have done in the case of the Mammals; but to have done so would have trebled the size of the Volume. To have appended the names of the Orders without any descriptive or illustrative remarks seemed out of place in a Volume of this nature.

Should this Work fall into the hands of any specialist, I would ask from him a kindly criticism : he will remember for whom it is written, and that while it of necessity must err largely by sins of omission, it has not always been easy over so vast a range to avoid falling into sins of commission.

The divisions of the Animal Kingdom given on page vii., under the heading of "General Contents," take the place of those referred to on page 3 of the Introduction.

I have to thank the Council of the Zoological Society of London for the use of the pretty woodcut on page 58, and the Council of the Linnean Society for the use of those on pages 606, 608, 609.

ANIMAL LIFE;

OR, THE NATURAL HISTORY OF ANIMALS.

THE question may be asked what is meant by the term Natural History. The word "Nature" is derived from the Latin *nasci*, to be born, to come into being; so that we may regard the aggregate of all that comes, or has come into being, or of all that we can by our senses perceive to have come into being, as objects of nature or natural objects; and the story of all such objects, the telling about their coming into being, of what they consist when thus born, of their growing and changing into adult forms, of their duration and of their dissolution—all this is what we call Natural History.

On studying the world of matter, one is led to study also the forces apparently inherent in matter, and the laws according to which such forces act; and such a study, as vast as it is interesting, is called Physics. While Physics thus investigates the common properties of bodies, Chemistry searches out the peculiarities of their component parts, resolves them into substances that seem to admit of no further resolution, and calls these elementary. It then inquires into the properties of the elementary bodies, and nowadays, having unravelled an immense portion of Nature's web, it sets itself to try if it cannot weave, it may be, ever so little a portion.

Leaving the Physicist and the Chemist with their hands fully occupied, we turn our eyes to regard existing or past forms of matter from another point of view, and we find that they fall into two great sections in a most natural way. In one group we find the outline, or figure, of the bodies for the most part irregular, or if, as in crystals, regular, then bounded by right lines and angles. If we examine the internal structure of such bodies, it will be found to consist of an accumulation of similar particles. Indeed, we may regard it as practically structureless or homogeneous; and, again, if we chemically examine such, the variety of their composition will be well marked and striking. To such a group the title of Inorganic has been given. Inorganic bodies can increase in bulk only by external addition of similar or homogeneous parts, and to acquire a knowledge of their nature is the object of Mineralogy.

In the next group we find the presence of life, an agent only known to us by its effects, and most difficult, if it be not indeed impossible, to frame a definition of. The attempt to give a definition of life has, as we are reminded by Lewes, in his charming work, "The Physiology of Common Life," been often attempted, but never with entire success; and then he gives us as the most intelligible and easiest-remembered definition, "Life is the dynamical condition of the organism." This embraces every form of life, from that of the simple cell to that of the most complex mammal. For our present purpose, however, we will the rather try and find evidence of what this life is, by contrasting this second group, called Organic, with the first. We find that the figure of living forms is rarely, if ever, angular, being, on the contrary, bounded by convex surfaces, and always more or less rounded; that the internal structure of their bodies is resolvable into many distinct parts, which are again found to consist of what we are pleased to call elementary structures, a complete comprehension of which still baffles our investigation. In their mode of increase, too, these offer a marked contrast to Inorganic bodies, as they add to their substance by the assimilation of matter taken into the substance of their bodies, a process generally known as growth.

We can thus divide beings that have existed, or at present exist, into Organic and Inorganic, and the former of these contains beings endowed with life. The science that treats of living beings is called Biology, and the Biologist has to study both Plants and Animals. Linnæus divided Nature into three kingdoms—1, Mineral kingdom; 2, Vegetable kingdom; 3, Animal kingdom. Recollecting the previously-mentioned facts, there will be little danger of the members of the first of these being confounded with those of the two latter; and, at first blush, there appears no reason why the members of the vegetable kingdom should be mistaken for, or confounded with, those of the animal kingdom. As it has been well said, nothing can be more unlike than the cow and the grass on which she feeds. But infinitely varied are the forms of both vegetable and animal life, and in our investigation of the latter we shall come across forms of which many cannot say to which of these two kingdoms they ought to belong; but while this is quite true, yet it will be well to recollect that, leaving the so-called Primitive Animals (*Protozoa*) for the moment out of sight, we find in those animals furnished with a digestive (alimentary) system (*Metazoa*), certain phenomena which are characteristic, and which are absent in vegetables. 1. Their food is first received into an internal digestive cavity, and then is subsequently elaborated. 2. This food must be organised matter, previously stored up in the bodies of other living beings. Nor, while thus trying to be exact, would it be right to forget that, talking in a general way, animals have a nervous system—plants have not; animals have powers of locomotion—plants have none; animals seek for their prey—plants do not; and that while nitrogen is present in animals, as an ultimate constituent, in much greater quantity than in plants, carbon is in plants the predominant element.

In their ushering into being, the Three Kingdoms of Nature came, in all probability, thus:—First, the Mineral; then, drawing its sources from the mineral, came, secondly, the Vegetable; and, thirdly, appeared the Animal Kingdom—first the vegetable-feeders, then the flesh-eaters. It is not without interest to consider how in the course of Nature these latter two kingdoms, depending thus directly or indirectly on the first, do in good time return once more to the dust (inorganic kingdom) from whence they came, borrowing and somewhat transforming certain substances, but not adding to the total aggregate of nature. For a time escape may appear possible; but in course the end must surely come. Preserved in our earth—buried deep—the magnificent cryptogams of our coal measures might well seem to have escaped their doom; but now we tear them up, at vast cost of life and labour, and on the million fires throughout our lands we sacrifice them up, utilising about a tenth of their stored-up carbon, and sending the rest out in foul clouds that stream away with the wind; or those great stores of coprolites, excreta of certain extinct fish and reptile-like forms that ages ago swarmed on our coasts, first passed as indigestible by the mighty icthyosaurians, buried in the lias out of sight, long since most of the bodies of their excretors have been resolved into the elements; but nowadays are these remains dug out, dissolved by acid, and made to furnish nutriment to our green crops; and so, somewhat more slowly, but quite as surely, will be resolved into the elements too. The inorganic kingdom is thus ever engaged in swallowing up the other two, which owe their very life and existence to it.

In this volume our attention is to be directed to the youngest of these kingdoms. We are to attempt to describe in a popular sense the forms and habits of Animal Life. This life did not spring into existence as we now see it. It had its own spring-time, when animal life was young, and the existing forms were few and simple, however widely scattered. The primitive forms were no doubt few, but the stem soon grew upwards, and branched out many ways, and the differences increased and multiplied, until the fruit of the twig from the stem that bore the Primates, the first order of which we will treat, might seem scarcely to be allied to that from the stem of the early primitive forms. But with these later grown branches, as being more clearly visible, we are somewhat more familiar. Every one knows something of beasts, and of birds, and of fishes, while many know but little of corals, and sponges, and moners; and as we wish that this book should be written for the many who want to know more about these so-called higher forms, it must happen that these older and less familiar forms cannot be treated of in the same detail. This must serve as our apology for the somewhat unequal treatment in this work of some portions of the animal kingdom; for the interesting stories about monad are not by any means as numerous as those about monkeys, nor have sponges as yet obtruded themselves on our notice by assuming the impertinent physiognomies or intrusive habits of sparrows.

We found Nature consisting of kingdoms. We find her Animal Kingdom consisting of sub-kingdoms, classes, and orders, and these latter divisible into families, genera, and species. These divisions are established for the better understanding of the subject. Forms that resemble each other are kept together, and compared one with the other; and thus groups of more or less magnitude are formed. Indeed, every one has learned in some way to classify animals. Some classes, as those of beasts, birds, reptiles, and fishes, are known to most persons; but a scientific classification has to do with a vast number of little-known forms, and is bound to embrace them all. To group the tens of thousands of distinct forms into an orderly sequence has been often attempted, and the efforts in this direction of Linnæus, Cuvier, and others are well worthy of mention; and yet it is not too much to say that scarcely one group can as yet be logically defined—or, if there be one of which it can be said that by a definition we can include all its forms, and exclude none, it is the first that we meet with, *i.e.*, the Mammalia, and this the last formed. It will be seen, therefore, that the naturalist has not found out as yet a truly natural system of classification, but each new discovery seems to show him more surely the way; and though he has from time to time been led astray by the too close study of some striking character, yet presently he will be led to understand the true meaning, not of one, but of all the peculiarities to be met with in each animal form; then, filling in the last links, he will have the chain of descent so complete as to enable a truly natural system to be propounded.

If we examine any animal form, say that of a bird or cat, we perceive that each is made up of an aggregate of many systems. For example, in both bird and cat we find a skin (tegumentary system), showing feathers in the bird and fur in the cat. Beneath this there is a muscular system, and in close connection with this a bony or osseous system. A closer investigation will prove also the presence of a system engaged with nutrition—the alimentary system—and in attendance on it the important blood and nervous systems. Now, if we were to compare our bird or cat with a butterfly, a bee, or a garden snail, we should be struck at once with the fact that one of the six systems just mentioned had disappeared—the bony system is wanting in snail, bee, and butterfly. The arrangement of the systems, too, among themselves is slightly varied, but otherwise there is a good deal in common among all these; so much so, that a modern philosopher and naturalist, Ernest Hæckel, has proposed to group these and others together as one of the three principal groups of the animal kingdom, under the title of Blood Animals (*Hæmataria*); a second group, of Bloodless Animals (*Anæmaria*), would contain chiefly the zoophytes where the blood-system had disappeared, and with it, in a great measure, both the nervous and alimentary systems; the third group would be the Primitive Animals (*Protozoa*), where the germ animal scarcely divides itself into layers, and so all the special systems that we have alluded to may be said to be wanting.

These three great divisions of the parent tree can be again divided into the following sub-kingdoms:—1, *Vertebrata;* 2, *Arthropoda;* 3, *Mollusca;* 4, *Echinodermata;* 5, *Vermes;* 6, *Cœlenterata;* 7, *Protozoa.* Each one of these will contain classes, of which we shall see more as we proceed.

SUB-KINGDOM I.—VERTEBRATA.

Commencing with the first sub-kingdom, that of animals with a bony skeleton, as being the one possessing, therefore, the most complete series of systems, and one the minor divisions of which are bound together by many common characteristics, such as the relations of the alimentary, nervous, and blood-systems to one another; the presence at one stage or another of their existence of a gelatinous cord (Notochord), which in most places is replaced by a series of bones (vertebral column); the fact that they never possess more than two pairs of limbs, and that these limbs are never modified so as to act the part of foot-jaws. We find it divided into—1, Mammalia (beasts); 2, Aves (birds); 3, Reptilia (reptiles); 4, Batrachia (frogs and toads); and 5, Pisces (fishes). Each of these classes of vertebrate animals must in due course engage our attention.

CLASS I.—MAMMALIA.

The first class that will engage our attention is that of the Mammalia. In this class we find the following peculiarities, which will serve to distinguish it from all the others:—The skull is fastened to the spinal column by a double articulation; each half of the lower jaw is composed of but a single bone; the solid particles (corpuscles) of the blood are, for the most part, red, disc-shaped, and circular in form, and without a nucleus; there is a complete diaphragm, separating the contents of the thoracic cavity (the lungs, heart, &c.) from those of the abdominal cavity (stomach, liver, &c.); the air-tubes of the lungs do not end in air-sacs; the tegumentary system somewhere throughout its extent exhibits horny modifications of the epidermis, known as hair, scales, &c.; and, most essential feature of all, the young, after their birth, are nourished by a fluid called milk, which is secreted by glands called mammary glands, from whence the name of the class is derived. Very generally the little ducts which form these glands open upon one common elevation, known as the teat, or nipple. To this the young mammal applies its mouth when moved by the sensation of hunger. Although in each order of Mammalia many apparent differences in the degree and form of development of the various systems so often alluded to will be met with, yet it seems most convenient that we should give a general sketch of the peculiarities of each system as introductory to our special study of the orders.

The Tegumentary System.—This system will come more particularly under our notice when considering the different natural orders. As a rule, the skin or integument of mammals is covered with hair, but in the Cetacea or whales hair is absent. In some mammals it is covered with horny scales (*Manis*), or bony plates (*Dasypus*), or spines (*Erinaceus*). In some, as in the rat and beaver, there is a mixture of hair and scales. The texture and quantity of the hair varies much, and so also does the thickness of the integument to which the hair is an appendage, being of great thickness and immensely rigid in the rhinoceros, and being wonderfully thin and fine in some rodents.

In connection with hair and scales must be mentioned nails, claws, horns, and hoofs, the various forms of which will be mentioned presently. There are two classes of tegumentary organs, differing in structure, chemical composition, and mode of development. First, the horny and glandular organs produced by the conversion of the outer layer of the skin (ecderon), which latter we may regard as the free area of metamorphosis of the external covering of any animal. Second, certain structures, which appear very frequently to be developed by a process of excretion. Of the former, we have nails, hoofs, the horny sheath of the horns of some ruminants, as well as hairs and spines. These latter, in addition to their own proper structure, are at first wholly, and always partially, enclosed in peculiar sac-like forms. These sacs, as in the case of the hair-sac, are often formed by a turning-in of the whole of the skin, so that they are composed of both an inner (enderonic) and an outer (ecderonic) portion. Among the conversionary productions of the outer layer are the so-called glands, which organs are engaged in the secretion of a fatty substance (sebaceous glands), or in that of a clear fluid (sweat glands). Between these two it is very difficult to draw any clear line of demarcation.

The Osseous System.—The skeleton of mammals varies in the different groups. It consists of a back-bone composed of a series of individual bones, called vertebræ, hence the name vertebral column, to which are articulated the skull, a series of ribs, and the anterior and posterior extremities, or legs and arms. The vertebral column is divided into five regions—the cervical, the dorsal, the lumbar, the sacral, and the caudal. In some animals, as in the whales, there is but little distinction between the lumbar and the sacral regions. Although the neck or cervical region varies much in length, being in the gorilla about one-seventh of the whole vertebral column, while in the giraffe (Fig. 1) it is about three-sevenths, yet it is found to consist, with perhaps three exceptions, of seven vertebræ. In animals having hoofs (Fig. 1) it has been remarked that the length of the neck corresponds in great measure to that of the fore legs; but the elephant (Fig. 2) forms a noteworthy exception to this rule.

There are generally thirteen dorsal vertebræ, as in most of the ruminating mammals, many of the rodents, and carnivores. Sometimes there are fewer than twelve, and rarely do we find more than fifteen; but the horse has eighteen, elephants from nineteen to one and twenty, and one of the sloths has three or four and twenty, which number is the largest known in the Mammalia. The number of lumbar vertebræ varies between two and nine. The most common number appears to be six or seven. In a few only is it eight or nine, and in some edentates and in the ornithorhynchus but two are to be met with. The sacral vertebræ are generally four in number, but vary from one to nine. In no division of the vertebral column is the number of the component vertebræ subject to such differences as in the caudal region. In the long-tailed manis there are forty-six vertebræ, but two or three in the orang-utan, while in the squirrel-monkey there are nearly thirty.

The first vertebra has two hollow spaces for the reception of the two bony bosses (condyles) found at either side of the large opening (occipital foramen) in the base of the skull. By this articulation is the head depressed and raised. The first vertebra also hinges on the body of the second vertebra by means of a finger-like process, so that while rotation takes place, the head rolls round with the first vertebra. In the whales this power of rolling the head is wanting. Generally the cervical vertebræ are distinct one from the other, but sometimes they are joined together in a bony union (anchylosed). In some, as the porpoise, all the seven are joined in one; in others, as the dolphin, only the first two; while in the whales the amount of anchylosis varies. Bony ridges (spinous processes) are sometimes developed from the cervical vertebræ, but not generally to the same extent as in the case of the dorsal vertebræ. More especially in hoofed animals they are very commonly long. To these processes the neck (cervical) ligament is attached. This ligament is present in most ruminants. In the horse it is powerfully developed, arising even from the lumbar vertebræ. Among the carnivores it seldom rises farther back than from the first dorsal. Forwards, it is attached to the spinous processes of the second cervical vertebræ, and often to the crest of the occipital bone of the skull.

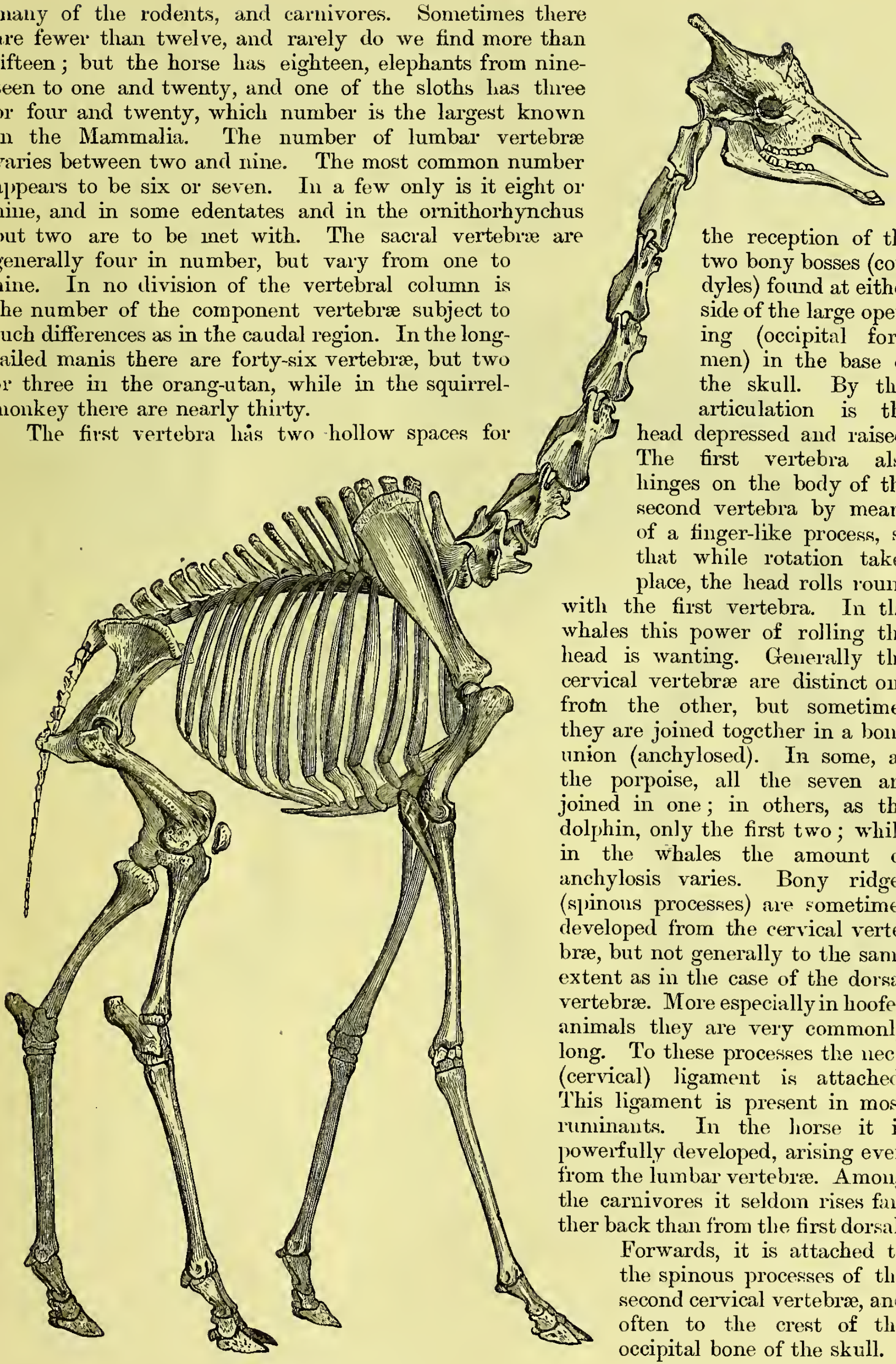


FIG. 1.—SKELETON OF GIRAFFE.

There are three bony cavities attached to the vertebral column—the skull, the thorax, and the pelvis; and to these we have the lower jaw, the anterior, and the posterior limbs respectively attached as appendages.

Let us consider the bony pelvis first. Behind we find the sacral vertebræ, and then the two large bones (ossa innominata), to which are articulated the hind limbs. This pelvis is sometimes almost wanting, traces alone of the innominate bones being found in the cetacea, and these, even, not connected with the sacral vertebræ, except by muscles. The sacral vertebræ, which form the back wall of this cavity, generally coalesce, and they vary from one to nine, forming the sacrum, which is, however, very obscurely indicated in the cetacea. Each innominate bone is made up of three bones (ilium, ischium, and pubis). Two of these—the pubic bones—generally unite in front, thus forming the front wall of the bony pelvis; yet in some animals they remain open. In different animals the ischia also become united. In monotremes and marsupials a triangular-shaped flat movable bone is attached to the anterior margins of the pubic bone on each side. These are called the marsupial bones (Fig. 3). A deep hollow cavity at the outside of each innominate bone receives the head of the thigh bone. The bones of this limb, including the knee-cap (patella), are thirty in number in the higher primates, but vary very considerably in the different genera. They are the thigh bone (femur), which articulates with the innominate bone. This, which is the longest bone in the human skeleton, is in most mammals generally relatively shorter. In the seals, the shaft of this bone almost disappears; in the apes, this bone forms an obtuse angle with the pelvis; in the carnivores, it forms nearly a right angle; while in the horse and some ruminants it forms even an acute one. With this bone are connected the bones of the leg (the tibia and fibula), The anterior surface of the knee joint is covered by the knee-cap (patella), which, broad in the horse and other perissodactyles, is small in carnivores, and wanting in some marsupials. In various mammals the two leg-bones coalesce, mostly

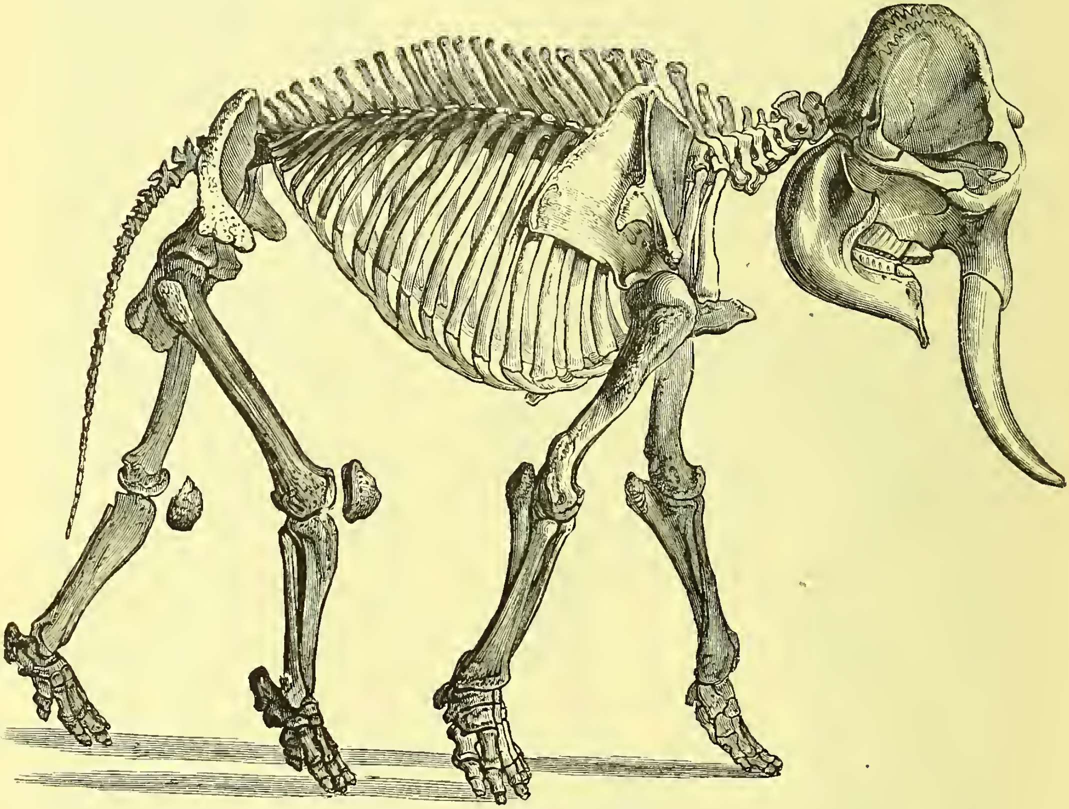


FIG. 2.—SKELETON OF ELEPHANT.

at the lower part. In the horse, the fibula is a long bone (stile) extending from the upper extremity of the tibia, while in ruminants it is the inferior end that is present. The foot is composed of a number of bones, grouped in three divisions—the tarsus (foot), the metatarsus (fore-foot), and the phalanges forming the toes. The first tarsal bone (astragalus) is connected above by a hinge-joint, with the tibia, and below with the heel-bone (calcaneum). These two are the principal bones of the root of the foot. Besides these, there are in some mammals, such as the primates, carnivores, and in many rodents, five other bones, and in the edentates these are more numerous. The entire number in the camel is six, but the other ruminants have but five, there being two cuneiform bones instead of three, and the navicular bones coalesce with the cubiform. The fore-foot (metatarsus) usually counts as many bones as there are toes present, the largest number being five, the smallest one. In the one-toed horse, rudiments of the second and fourth metatarsal are present on either side of the third metatarsal. Although generally distinct, yet in the ox the third and fourth metatarsals are coalesced; and in the jerboa, among the rodents, the three middle metatarsi form but a single bone. In the two-toed sloth, two of the five metatarsi bear no phalanges; while among the kangaroos, two of the four are very feebly developed.

The number of the toes (digits) varies within the limits mentioned for the metatarsus. There are five in the gorilla, four in the pig, three in the rhinoceros, two in the ox, and one in the horse. The number of joints in each toe also varies much. In the man-like apes, there are two phalanges in the big toe, and three in each of the remaining four, making fourteen in all. This is the normal complement of phalanges in the mammalia, which is not exceeded save in some cetacea. The big toe (digit 1) is the one absent in the pig; the little toe (digit 5) is absent in the rhinoceros; digit 2 is not found in the ox; and, lastly, digit 4 is wanting in the horse.

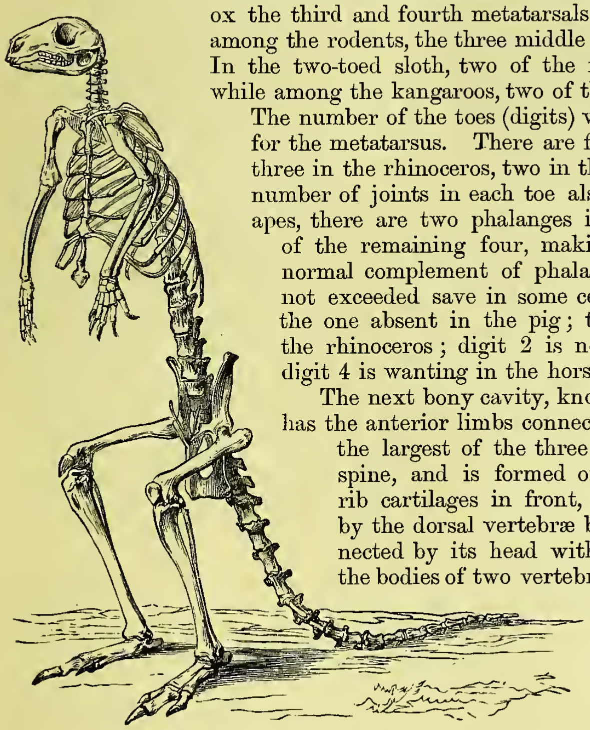


FIG. 3.—SKELETON OF KANGAROO.

The next bony cavity, known as the chest cavity, or thorax, has the anterior limbs connected with its upper portion. It is the largest of the three bony cavities connected with the spine, and is formed of the breast-bone (sternum) and rib cartilages in front, by the ribs on each side, and by the dorsal vertebræ behind. Each rib is usually connected by its head with an articular cavity, formed by the bodies of two vertebræ, and in addition, by means of a bony projection to the transverse process of the posterior of the two vertebræ. In monotremes the ribs are connected with the body of the vertebræ alone. In the cetacea many of the ribs are attached to the transverse processes only. The parts of the ribs which are united to the breast-bone generally remain in a soft (cartilaginous) condition; but in some these pieces become quite bony. The anterior ribs are always connected with the breast-bone, and are called true ribs, to distinguish them from the posterior ones, which are called false ribs, and some of which, having their anterior extremities free, are called floating ribs. The true ribs, of which there are mostly seven, eight, or nine, generally exceed in number the false. In most mammals the breast-bone is made up of a number of flat, bony pieces, arranged in a row. These are generally long and narrow, but in the cetacea they are broad, in some mammals (mole, some bats) the breast-bone has a projecting ridge like that to be met with in most birds. Sometimes the number of true ribs may be augmented by the appearance of neck (cervical) or loin (lumbar) pairs.

The anterior limbs are never absent in mammals; in this they form a contrast with the posterior ones. The shoulder-bone (scapula) is always present. It is, for the most part, attached to the upper and outer portion of the chest or thorax by means of muscles, so that it can be readily heaved off from its place. It is a flat, more or less triangular bone, with a projecting crest, the spine, which usually divides its outer surface into two unequal parts, as can be well seen in the shoulder-blade of the sheep. This spine ends in a well-marked process, which constitutes the top (acromion) of the shoulder, and to which the collar-bone (clavicle) is attached. This latter bone is attached by its other extremity to the breast-bone. The collar-bone is not met with in the ungulate animals, nor in the cetacea, and is also wanting in some of the edentates. In the sloth it seems to be attached to the process of the shoulder, which resembles a crow's beak (coracoid), and with the acromion process. It is often present in an imperfect state, as in most of the carnivores and some rodents. The shallow (glenoid) cavity of the shoulder-bone receives the upper arm-bone (humerus). This in some of the primates is nearly straight, but in the carnivores it is much bent. It is short in the ruminants, especially short in the cetacea, but long in the sloths. With the inferior extremity of the humerus the two succeeding bones of the fore-arm are connected by a hinge-articulation. The elbow-bone (ulna) is the inner of the two, and forms the chief portion of the articulation with the humerus; the radius is the outer, and while it forms but a small portion of the elbow joint, its lower extremity forms the chief part of the wrist. The radius can partly roll round the ulna, so that either the back or the palm of the hand can be turned upwards. But this power is not possessed by those animals who use their arms for standing and locomotion only. In most of the ungulates the two bones of the fore-arm will be found joined together. Although the ulna is often the larger of the two, yet we find it often wanting, or nearly so. Thus in the horse it consists only of the process of the head of the elbow, and a splint of bone not extending to the carpus; and it would seem to be absolutely absent in some of the wing-handed mammals. The hand may be divided into the wrist (carpus), palm (metacarpus), and fingers. The wrist consists of from five to eleven small bones. These are often arranged in two rows. The boat-shaped (scaphoid) and the moon-shaped bones (lunare) articulate with the radius; the pea-shaped bone (pisiform) forms in the carnivores, and in some of the apes, a kind of heel at the back part of the carpus. The palm or fore-hand (metacarpus) commonly consists of five small elongated bones, generally corresponding to the number of the fingers. In the ruminants there are but two bones, and these coalesce so as to form a single bone. In the horse there is but a single metacarpal one, though there are the remains of two others, forming splint-like bones, which are to be found at either side of the single (cannon) bone. The number of fingers varies from one to five. The latter is the normal number. Of these the third, or middle finger, is the most constant, and this is commonly also the longest. The thumb is often wanting, then the fifth finger, and after these the fourth. In some ruminants only the third and fourth are present. In the horse only the third finger is present.

Perfect fingers have three joints (phalanges), except the thumb, which has only two. In the whales and dolphins the number of phalanges, especially those in the second finger, is, however, larger. In ungulate animals, the last joint of the fingers is flat beneath. In some of the cats, the last joint has an S-shaped (sigmoid) form. It is excavated in the front, and a compressed conical point arises in the middle of this cavity. To this bone the claw is adapted. In walking this joint is turned directly upwards, and thus the point of the claw does not touch the ground. At some distance from the inferior extremity of this joint is found the articulation for the preceding second joint. This second joint has almost the form of a triangular prism; it is flat below, excised on the outer side, so that the last joint of the finger when at rest lies in it. Whenever the muscles which are attached by their tendons to the last joint of the finger bend that joint, the erect claw is drawn forward and downward. When at rest the last joint is supported by two elastic ligaments, which at the back of the hand proceed from the first and second phalanges to the upper margin of the last. In many of the primates the thumb can be moved separately and placed opposite to each of the other fingers.

According to some, the skull cavity is composed of a number of vertebræ; but if one examines closely the now known facts regarding the structure and development of the skull, it seems obvious that while these place the unity of organisation of the vertebrate skull upon a very sure footing, they clearly negative the hypothesis that the skull can in any sense be regarded as a modification of any number of vertebræ. For descriptive purposes we may regard the skull, say of a chimpanzee, as being divided into the cranium, or head, and the face; the former with eight (occipital, two parietal, frontal, two temporal, sphenoid, and ethmoid) and the latter with fourteen (two nasal, two superior maxillary, two lachrymal, two molar, two palate, two inferior turbinated, vomer, and inferior maxillary) distinct bones.

In some carnivores, in the bats, horse, the ruminants, and rodents, the two side (parietal) bones of the skull coalese to form a single bone, while on the other hand the forehead (frontal) bone in many mammals is formed of two bones. The large opening (foramen) in the occipital bone is usually, with the exception of some of the primates, situated more at the posterior extremity than on its inferior surface, so that the skull lies more in the same direction with the back-bone. The division of the wedge-like (sphenoid) bone into two persists in most mammals for their whole life. The cavity of the skull presents on its upper surface a tolerably smooth region, but on its basal surface it is very uneven, and may be divided into two or three regions. The posterior contains the portion of the brain called the cerebellum, and in most carnivores, in the horse and some other mammals, there is a bony partition which partially separates this region from the others.

The face bones vary immensely; the nasal bones are large in the carnivores, the horse, swine, in rodents, and in the rhinoceros. In this latter animal they support the horn by which this genus of animals is distinguished, although in the two-horned species the posterior horn is set upon the frontal bone. The lachrymal bones are often very largely developed, forming in the ruminants, and in some edentates, a large portion of the front of the face. This facial portion has in some ruminants a deep groove, in which large sebaceous glands are lodged. The superior maxillary bones are sometimes greatly elongated, as in some ant-eaters, the manis, and the true cetaceans. The malar bones are sometimes wanting, as in the sorex, the centetes, and the manis.

Most mammals have teeth; the genera manis and myrmecophaga are, however, entirely destitute of them. In the ornithorhynchus, horny teeth are present, and some whales have transitory teeth, succeeded by whalebone substitutes in the upper jaw. In the narwhal the single tooth is developed into a tusk-like form, while in the dolphins the greatest number (one hundred and ninety) met with among mammals is found. It is peculiar to this class to have teeth implanted in sockets by two or more fangs. This can, however, only happen in the case of teeth with limited growth, for perpetually-growing teeth require the base to be kept simple for the constantly-growing root. Teeth implanted in sockets are in this class to be met with only in the jaw (maxillary—pre-maxillary) bones forming a single row in each. They usually consist of a hard substance (dentine), defended at the crown by an investment of enamel and ivory, surrounded by a coat of cement. The proportions of these substances differs in the different groups; thus the coronal cement forms an extremely thin layer in the teeth of the primates and most of the flesh-eaters; it is thicker in the teeth of the herb-eaters, more especially in the complex grinders of the elephant; and is thickest in the teeth of the sloths, walrus, and others. The great tusks of the narwhal, walrus, and elephant consist of a modification of dentine, which in the elephant is called "ivory," and is covered by cement. The front teeth are generally called "incisors," or cutting teeth, while the back teeth receive the name of "molars," or grinding teeth; and large conical teeth situated behind the incisors, and adapted by being nearer the insertion of the biting muscles, to act with greater force, are called "holders," "tearers," or from being well developed in the dog and other carnivores, "canine" teeth. The various forms of teeth will be best seen when the dentition of each class is being considered.

It has been already mentioned that mammals have two jaws, in which the teeth are implanted. The under jaw (inferior maxillary bone) alone is movable. In ourselves this motion is threefold: first, the jaw can be depressed and then raised; secondly, it can be extended forwards and then retracted; and lastly, it can be moved obliquely from side to side with a rotating motion. These motions are rendered possible by the roundness of the articulating surfaces (condyle) of the jaw, and the slight depth of the articular cavities (glenoid) of the temporal bones. In most mammals these motions are much more limited. In carnivores the forward and backward or to and fro motion is prevented by the depth of the transverse grooves which receive the condyles of the jaw. In rodents these condyles are placed in a longitudinal, not transverse manner, so that the under jaw can slide backwards and forwards with great facility, which, indeed, is the principal motion made use of in gnawing. Again, in the ruminating animals, the articular groove is very shallow, while the condyles are flat and transverse, and the lower jaw is narrower than the upper; so that the lateral motion is here greatly developed, as can be seen by watching a cow while she is chewing her cud.

The Alimentary (Digestive) System.—In close connection with the bony system is that engaged with alimentation. Upon this system being properly supported depends the welfare of all the structures of the body, so, nearly all the systems in some way or other aid in its support. The many varied modifications of external form have all the one great purpose of collecting, conveying to the mouth, and masticating therein the several substances required to enable the alimentary system to keep itself and all the other systems in working order. Omitting from our consideration the instincts that compel the animal creation to increase and multiply, instincts that only arise in adult life, and last then but for a season, and the special traits of character that seem to spring therefrom, we find that the every thought of an animal is devoted to the search for food. From their birth to their death their one great aim is to get their meat in due season. The ways of obtaining this food are many, and this subject has even left an impress upon our classification, for we talk of rodents and carnivores, referring to marked difference in their method of obtaining the same. The long tails of the American monkeys enable them to swing from tree to tree, that they may gather the fruits they live on; the long nose of the elephant and the long neck of the giraffe bring the green leaves within reach, and each animal being, as it passes our survey, will exhibit some special adaptation of its form, enabling it to supply its alimentary system with the proper nourishment. Nor in writing thus do we overlook the equally evident fact that a further power, in the thus moulding of an animal's external form, is at work in the struggle to avoid, as far as possible, falling a prey to others. We might inquire, as we examine the various mammals treated of in the following pages, as to the means they had of obtaining food for themselves and of avoiding becoming the food of others, and thereby well account for most of the peculiarities we shall meet with.

The organs for alimentation are the mouth (in which are the teeth and salivary glands), pharynx, gullet, stomach, and intestines, and sundry accessory glandular organs. At the base of the cavity which forms the commencement of the alimentary canal is the pharynx. It is formed by a continuation of the integuments of the nasal cavity and of the mouth. It is at first wide, and then narrows into the gullet (œsophagus), which is a nearly cylindrical tube running through the cavity of the thorax. It is generally the narrowest portion of the alimentary tract. When it perforates the diaphragm it enters the abdominal cavity, and in most mammals immediately dilates into the stomach. This large dilatation has two orifices, the one receiving the œsophagus, called the cardiac orifice, the other, where the stomach passes into the intestine, the pyloric orifice. In most mammals the stomach is a simple sac, as in most of the tailless monkeys; but often the cardiac portion is divided by a construction from the pyloric portion. This is very conspicuous in many rodents, and in some species there is in addition an accumulation of glandular structures at this portion, putting one in mind of a bird's stomach. In some monkeys the terminal portion of the stomach is pouch-shaped (sacculated). In the kangaroos the whole extent of the stomach is sacculated, and looks like a portion of the large intestine.

In the sloth and the carnivorous cetaceans, and also in a measure in the sirenians, the stomach is also composed of different divisions, but in the ruminants especially does the compound stomach (Fig. 4) deserve a particular notice. The grass, which is devoured in large quantities by these animals, and which undergoes but little mastication in the mouth, is hastily swallowed, and is received through the œsophagus (*a*) into a capacious reservoir, called the paunch (*b*). This cavity is lined internally with a thick membrane, beset with numerous flattened, almost horny, projections, and is often divided into pouches by transverse contractions. While the food remains in this bag it continues in rather a dry state; but the moisture with which it is surrounded contributes to soften it, and to prepare it for a second mastication, which is effected in the following manner:—Connected with the paunch is another, but much smaller sac, which is considered as the second stomach; and from its internal membrane being thrown into numerous irregular folds, forming the sides of polygonal cells, it has been called the honeycomb stomach (*c*). A singular connection exists between this stomach and the preceding; for, while the œsophagus appears to open naturally into the paunch, there is on each side of its termination a muscular ridge which projects from the orifice of the latter, so that the two together form a channel leading into the second stomach, and thus the food can readily pass from the œsophagus into either of these cavities, according as the orifice of the one or the other is open to receive it; and liquids drunk by the animal pass at once into the second stomach, the entrance into the first being closed. The food is subject to a rotatory movement in the paunch, and is transferred, by small portions at a time, into the second, or honeycomb stomach, in which there is always a supply of water for moistening the portion of food introduced into it. It is in this latter stomach, then, that the food is rolled into a ball and thrown up, through the œsophagus, into the mouth, where it is now masticated at leisure, and while the animal is reposing, a process which is well known as chewing the cud, or rumination. After the mass has been thoroughly ground down by the teeth, it is again swallowed, when it passes along the œsophagus into the third stomach (*d*)—called the manyplies, or psalterium—the orifice of which is brought forward by the muscular bands forming the two ridges already noticed, which are continued from the second stomach, and which, when they contract, effectually prevent any portion of the food from dropping into either of the preceding cavities. In the ox, this third stomach has the form of a crescent, and contains four-and-twenty septa, or broad folds of its inner membrane. These folds are placed parallel to one another, like the leaves of a book, excepting that they are of unequal breadths, and that a narrow fold is placed between each of the broader ones. Whatever is introduced into this cavity must pass between these folds, and describe three-fourths of a circle, before it can arrive at the orifice leading to the fourth stomach (*e*), which is so near to that of the third, that the distance between them does not exceed three inches.

There is, however, a more direct channel of communication between the œsophagus and the fourth stomach, along which milk taken by the calf, and which does not require to be masticated, is conveyed directly from the œsophagus to this fourth stomach; for at that period the first and second cavities of the stomach are not yet fully developed; and in these animals rumination does not take place till they begin to eat solid food. It is in this fourth stomach, which is called the red, that the proper digestion of the food is performed, and it is here that in the calf the coagulation of the milk takes place; on which account the coats of the calf's stomach are employed in dairies, under the name of rennet, to obtain curd from milk. A regular gradation in the structure of ruminating stomachs may be traced in the different genera of this family of quadrupeds. In those with horns, as the bullock and the sheep, there are two preparatory stomachs for retaining the food previous to rumination, a third for receiving it after it has undergone this process, and a fourth for effecting its digestion. The camel, dromedary, and llama want the third stomach. The food being masticated in the mouth, and slightly altered by the action of the saliva in its starchy elements, is subjected in the stomach to a further series of processes, that is to say, it is there mixed, macerated, and liquefied, the fats become oils, the sugars are a little altered, the albuminous matters are somewhat changed, and the whole mass becomes chyme. This passes into the first portion of the small intestine through the pyloric orifice, and is now to be transformed into chyle. The small intestines are mostly longer than the large intestines, and on the inside are generally beset by small projections (villi). At the union of the large and small intestines there is usually found a blind pouch (cæcum), which is prolonged into the large intestine (colon), which terminates in the rectum. Except in the monotremes, the termination

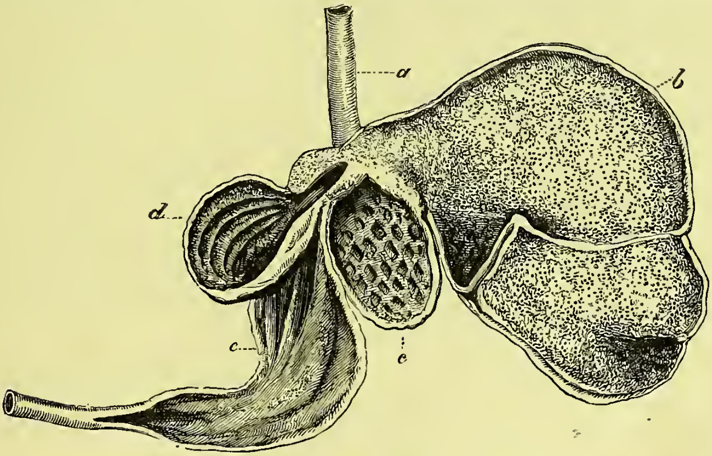


FIG. 4.—SECTION OF STOMACHS OF A RUMINANT.

of the intestinal canal is always distinct from the urino-genital opening. In general the intestinal canal is longest in vegetable-feeders. Thus in the ox it is about one hundred and fifty feet long, in the elephant it is about sixty feet, while in the carnivores it is usually shorter, being in the bear about twelve times the length of the body, in the cats from three to four times.

The chyme is in the intestines subjected to the influence of three fluids—the bile, secreted by the liver; the pancreatic juice, secreted by the pancreas; and the intestinal juice, secreted by glands to be found in the inner coating of the intestine. By the united action of these, fats are reduced to an emulsion which permits their being absorbed, starch is completely converted into a sugary substance (glucose), and any unaltered portions of muscle are converted into another digestible material (peptones).

Of the two important organs just alluded to it will be necessary to say a word. The liver is situated, like the stomach, below the diaphragm, and generally to the right side. In flesh-eating animals it is divided into a number of lobes, and the greater the number of its divisions the more does it extend to the left side. In those mammals with a divided or compound stomach it is comparatively small, and little divided. It is the largest of all glandular organs, and is mainly engaged in the secretion of bile, though it also effects important changes in certain constituents of the blood on its passage through the gland. The gall-bladder is the reservoir for the bile; it is wanting in a great number of animals, such as the rhinoceros, elephant, tapir, horse, sloth, some rodents, camel, llama, deer. In carnivorous animals, excluding cetacea, and in the monkeys, it is present. In most mammals the bile is carried to the gall-bladder by the same route as that by which it is again conducted from it, and in most cases the bile-duct of the liver joins with that of the gall-bladder to form a common canal, which conducts the bile into the first portion of the small intestine (duodenum). The pancreas is placed between the duodenum and the spleen, behind the stomach. Perhaps every one is acquainted with this gland, as it occurs in the calf, where it is known as sweetbread (ris de veau). There have been great disputes respecting its functions, but according to Bernard its secretion, which enters the intestine either close to the entrance of the bile-duct, or, forming a common duct with it, possesses the property of forming fats into an emulsion, transforming starch into sugar, and of acting on albuminous substances. In its passage through the intestines, and having been duly acted on by the secretions of these glands, the chyme has become altered into a nutritive fluid called chyle. Some small portion of this is taken up by a series of vessels called the lacteals, and is thrown into a large (subclavian) vein, so entering the general circulation; but the chief portion is taken up by an enormous number of veins, which, uniting to form one large (the portal) vein, carry the newly-made chyle to the liver. And here we must take up the consideration of the next great system—that called

THE BLOOD SYSTEM.—This in mammals consists of a central receiving and propelling organ called the heart, and of a twofold series of hollow, elongated vessels containing two sorts of fluid, the veins and the arteries, the whole forming a closed series of vessels in which the blood circulates. The heart is composed of four cavities, two auricles and two ventricles. These form two lateral halves, which, from their position, are called right and left, and each half contains an auricle and a ventricle. We have seen that the immense mass of small veins united to form one large (vena porta) vein, and that this enters the liver. Here it breaks up into a multitude of fine vessels (capillaries), which ramify throughout the liver. From this capillary mesh-work veins arise and unite into a common trunk (the hepatic vein), which opens into a bigger vein (inferior vena cava), into which also open the veins bringing used-up blood from the lower portions of the body. This inferior vena cava makes its way upwards, and opens into the right auricle of the heart, into which also opens another large vein (the superior vena cava), which conveys the used-up blood from the upper portions of the body, and in addition the milky fluid from vessels called lacteals. The contraction of this auricle thus containing impure blood drives that fluid into the right ventricle; this right ventricle then contracts and forces it into the (pulmonary) artery going to the lungs, from whence it passes into the capillaries of the lungs, where it is changed from venous to arterial blood by the passage of carbon dioxide and watery vapour out of it, and of oxygen into it. Leaving the lungs by four (pulmonary) veins, it returns to the left auricle, and the contraction of this sends it into the left ventricle. The left ventricle next contracts, forcing the blood into the largest blood vessel in the body (aorta), branches from which convey it into all parts of the body except the lungs, and from the capillaries of these various parts, except, to speak in general terms, those of the portal system, it will be conveyed into either the superior or inferior vena cava, and so into the right auricle. Such is a slight sketch of the circulation of the blood, and of the blood system as it would be met with in most mammals. The heart is invested by a covering called the pericardium; it is situated above the diaphragm in the thoracic cavity. In some monkeys it rests by one of its surfaces on the diaphragm being placed somewhat obliquely; but in most mammals it is placed in a straight line, and either does not reach the diaphragm at all, or at most only touches it with its apex. The form of the heart is various; it is obtusely conical, or of a shape generally recognised as heart-shaped, in the cow, horse, orang-utan, but is round in many monkeys. It is broad in the cetacea and elephants; it is short and obtuse in the sloths. In the dugong the outward division between the ventricles gives the heart the appearance of being double. The mode in which the principal stems arise from the arch of the aorta is various; so is the distribution of the arteries and veins; but to give details of these would lead us to far exceed our space.

We must regard the respiratory organs as forming a portion of the blood system. These consist of the lungs and air-vessels. The lungs are distinguished by the minute division of the respiratory (bronchial) tubes, and the so-called pulmonary vesicles are in immediate connection with their delicate ramifications. In most mammals these small bronchial tubes unite to form two (in some few, three) large bronchi, which unite in the trachea, or windpipe. This ends in the larynx, a chamber with cartilaginous walls, which is capable of being closed by a lid-like organism called the epiglottis. This opens behind the tongue, at the lower and front portion of the pharynx, and this latter, as we know, communicates by two channels with the outer air. The nasal passage, which may be regarded as the true external respiratory passage, remains, as a rule, open, and cannot be closed at will; the other—the mouth—serves the double purpose of securing food and air, and can be opened and closed at pleasure. The right lung is larger than the left, and has generally more lobes. Each is invested upon its external surface by an exceedingly delicate membrane (serous), the pleura, which encloses the organ as far as its root, and is then turned up upon the inner surface of the thorax. They, with the heart and some large vessels, fill up the cavity of the thorax, extending to the muscular partition, which we have often referred to, called the diaphragm, which divides the cavity of the thorax from that of the abdomen in mammals, and which is attached to the vertebræ, the ribs, and the breast-bone. When the diaphragm contracts it descends, the capacity of the thorax is increased, air fills the lungs, and inspiration is effected. When it ceases to contract, the elasticity of the lungs comes into play; the extra air is driven out, and so expiration is accomplished. In respiration, however, the ribs also play an important part.

While the lungs are engaged in enabling the blood to excrete carbonic acid, the skin enables it to get rid of a large quantity of water. Indeed, while the carbonic acid given off by the skin is not more than a fortieth part of that excreted by the lungs, the water excreted by the skin is, under ordinary circumstances, more than double that given off by the lungs. There is, however, another most important set of organs engaged in the purifying of the blood, called the kidneys. These organs, two in number, are situated in the lumbar region, near the vertebræ. In many mammals the right is a little higher than the left. The kidney tissue consists of an outer and an inner substance (cortical and medullary), and the function of the organ is to remove urea and uric acid from the blood. This blood, purged, as it were, of carbonaceous matters in the lungs, comes to the kidneys to be freed from nitrogenous matters, but the kidneys supply it with no oxygen. The urea and uric acid are soluble in water, which is also excreted by the kidneys. With some other products, this fluid is collected by two long tubes (ureters), which convey it to the bladder drop by drop. Here it accumulates, until the sensation that the bladder is full causes it to be expelled. This urinary bladder is smaller in carnivorous than in herbivorous animals; and in some carnivores, and in the carnivorous cetacea, the kidney departs from its characteristic shape, and consists of several masses, or lobes.

The vocal apparatus of mammals may be alluded to here. The larynx, in which the voice is formed, is situated at the top of the trachea, and consists of several cartilages. In some few mammals, air-sacs are found to communicate with the larynx. The larynx communicates with the cavity of the mouth by a fissure called rima glottidis. This is situated between the inner margins of two pieces of cartilage, and commonly there will be met with here the two superior or false vocal cords, and two inferior, which are the true vocal cords (chordæ vocales). In the cetacea these are absent, whereas in most ruminants the superior are wanting. In the ox the lower cord is long, and vibrates so as to produce the well-known bellowing roar; in the cow the same structure produces the lowing. In some mammals the larynx undergoes certain periodical developments, and thus there is produced the belling of the red deer, and the grunting of the roebuck. In the cat tribe, the upper vocal cords are unusually prominent, and by their vibration cause the purring sound. In the gibbons the vocal cords are well defined. If the mycetes has the loudest cry, the gibbons seem to have the greatest range of notes; they can, alone of all brute mammals, make an attempt at singing, and Professor Owen tells us that he has listened with astonishment to Hylobates agilis emitting the rising and falling scale of semitones throughout the octave.

THE NERVOUS SYSTEM.—This system in all mammals consists, firstly, of the brain and spinal narrow (cerebro-spinal) system. It includes those nervous organs in and through which the several functions of the mind are more immediately connected, the sense nerves, as well as those concerned in many nervous actions in which the mind has no connection. Secondly, the ganglionic, or sympathetic system, which appears to be more closely concerned with the processes of organic life. This system consists of a double chain of ganglia, or masses of nerve cells, connected by nervous cords, situated along the spinal column, and from which nerves with other ganglia developed upon them proceed to the viscera in the thoracic, abdominal, and pelvic cavities, as well as to certain regions in the head. These often unite with the nerves proceeding from the cerebro-spinal system, and form masses of nerve tissue, of which the largest is the solar plexus, and is situated behind the stomach.

The cerebro-spinal system consists of two parts, the spinal cord and the brain. The former of these is lodged in the spinal canal, and is surrounded by three membranes—first, the pia mater, a delicate membrane rich in vessels; secondly, the arachnoid membrane, which is a membrane (serous) of extreme thinness; and thirdly, and outside of all these, the dura mater, which is a strong fibrous membrane; thus securely is this important spinal cord protected. The spinal nerves take their origin from the spinal cord, and are transmitted through a series of openings between the vertebra on either side of the spinal column. The number of pairs of these nerves differs in various species according to the number of vertebræ. The dura mater extends farther back in the vertebral canal than the cord itself, and thus the last pairs of nerves, before perforating this membrane, take an oblique course, forming a lash of nerves (cauda equina) scarcely ever met with in the spinal cord of any other group of vertebrates. This is the more conspicuous where the spinal cord is short, as in bats, the hedgehog, and the echidna, where the spinal cord ends about the last dorsal vertebra, whereas in perhaps most it extends to the sacral vertebræ. In some mammals a narrow canal often runs longitudinally in the middle of the spinal cord—in others it is only present in a rudimentary condition in early life—continuous with the general ventricular cavity of the brain. It appears to be formed by the closing in of a previously open groove.

The upper part of the spinal cord is called the medulla oblongata, upon which is the superincumbent mass called the cerebellum. The brain mass which connects the hemispheres of the cerebellum together receives the name of the pons varolii. This bridge also forms the bond of union between the cerebellum and the two large masses of brain matter called cerebral hemispheres, which among the higher primates form far the largest portion of the brain (Fig. 5).

In the monotremes the medulla oblongata and cerebellum are large in proportion to the rest of the brain. In most cetacea the cerebellum is largely developed, and it is proportionally greater than the rest of the brain in rodents than in any other order. The cerebral hemispheres do not extend backwards so as to cover the cerebellum in the marsupials, edentates, or rodents; but in the carnivores and ungulates it will be seen to gradually push itself backwards, until in some of the primates, such as some of the anthropoid apes, and in the squirrel monkey (Chrysothrix), the posterior lobes of the cerebrum project over the cerebellum (Fig. 5).

The nerves from the skull are nine in number on each side. They are generally known by their number, according to the order in which they pass out of the skull cavity; but they are often also known by the name of the part to which each is distributed, or from some special functions belonging to each. Thus we have as nerves of special sense:—The olfactory nerve, presiding over the sense of smell; the optic, over sight; the lingual branch of the gustatory, over taste; the portio mollis (auditory), over hearing; a part of glosso-pharyngeal, over taste. As nerves of motion we have the Motor oculi; the Pathetic; the Abducens; the Portio dura (facial); and the Hypoglossal. As nerves of common sensation: the greater portion of the fifth nerve. A part of the glosso-pharyngeal. As mixed nerves: the Pneumogastric and the Spinal accessory.

The first pair of nerves are absent in all the cetacea save those with whalebone, where they are very small. With the solitary exception of the ornithorhynchus, where this nerve quits the skull by a single foramen, it is found on reaching the base of the skull to break up into a number of nerves which pass through the so-called cribriform plate, a bony piece well developed in echidna. The number of olfactory nerves is very great in marsupials, in the hedgehog, in carnivores, in ungulates, but decreases as we approach the primates.

The optic nerves are smallest in the moles, largest in the giraffe.

The fifth, or trigeminal nerve, is commonly the largest. It principally forms the nerves of sensation to the head, but it also sends branches to the sense organs. It is very large in the ornithorhynchus.

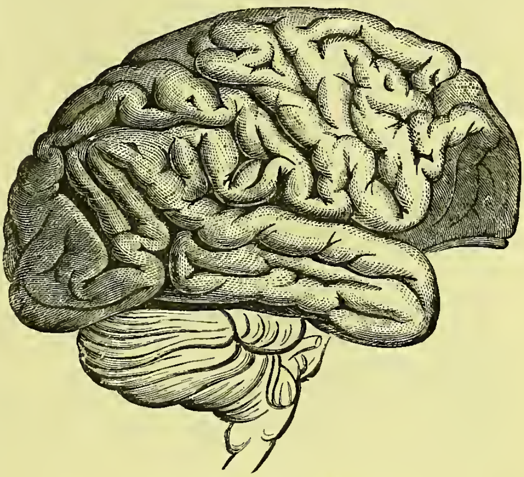


FIG. 5.—BRAIN OF ORANG.

In connection with the nervous system would be the place, if space allowed, to describe the special organs of sense, the ears, eyes, &c., and to treat of the various modes of progression in mammals, some being formed for swimming, others for flying, and the majority for walking or running. But in connection with motion we must not omit all reference to one more quite distinct system, which, covered over and protected by the skin, itself covers over and protects the osseous system, and, together with the systems that we have examined, builds up the complete animal form, namely,

THE MUSCULAR SYSTEM.—It presents two conditions of fibres, the striated and the non-striated. The striated kind comprises all the voluntary muscles and the heart, and is red. This colour varies, being deeper in cetacea and carnivores than in ungulates, and being very pale in most of the rodents. These muscles are generally composed of bundles of fibres united at their ends by tendons. The separate fibrillæ exhibit faint longitudinal striation. The non-striated muscle is devoid of striation, and does not break up into fibrillæ, while the former classof muscles are capable of being excited or controlled by the efforts of the will. These latter are often called the involuntary muscles, and are chiefly to be met with in the alimentary canal, in the bronchi, and in the coats of all arteries. Their functions are beautifully seen in the circular coloured muscle of the eye, and are often felt in the skin. Both forms of muscle are engaged in the production of motion. They either move part of the body or effect locomotion by moving it as a whole. One other source of motion may be alluded to; it is to be met with in minute bodies called cilia, which are very small prolongations of the free surfaces of some forms of (epithelial) cells.

The reader of this very brief sketch of the various systems that build up the mammalian animal will perceive how intimately connected these systems are the one with the other, and will see that, however convenient such an artificial arrangement may for some purposes be, yet that one can scarcely thus take asunder the whole mechanism of the animal; and we have been obliged to pass over until now mention of an important set of organs which are engaged in the reproduction of the species, and in the nourishment of their young. Of these glandular organs, one series, the mammary glands, give the name to the group. The young of all the Mammalia are born alive, and though always in a helpless condition, yet in a more or less perfect though miniature form. The very minute ova in the Mammalia are not furnished with a sufficient quantity of nutritive material (yelk) to enable them to develop themselves beyond the very first stage of their existence; and hence when they arrive in a fertilised condition in the maternal organ (uterus), the outer membrane of the ovum, or egg, attaches itself to the walls of that receptacle. Soon a highly vascular organism (placenta) connects the one with the other; and through this, and from its mother's system, the young animal derives the nourishment necessary for its growth until it attains its full development, when, on its birth, it once more, but in a different way, is dependent on its mother for its daily food, obtaining it now from her milk—a fluid secreted by peculiar glands called mammæ. These are situated on the ventral surface of the mother's body. When two in number, they are generally placed on the upper part of the chest, as in the primates, bats, sloths, sirenia, and elephant, and they are then called pectoral; but in some cases, as in the mare, ass, hippopotamus, the two mammæ are placed between the hind legs, and called inguinal.

In many ruminants, the mammary glands are compacted into a solitary roundish mass, more or less pendulous, called udders, as in the cow. Sometimes these glands occur in a double row along the whole lower surface of the animal's body, as in the rat and mouse, in the domestic pig, the dog, and others.

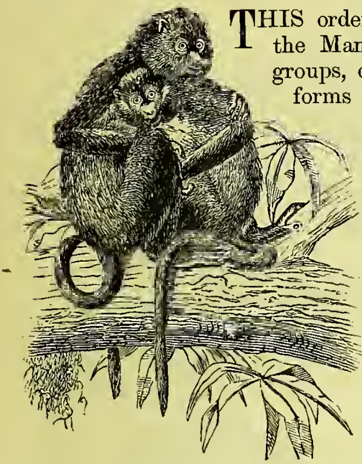
In one group of mammals a placenta is not developed, and the young animals are then born in a very rudimentary condition. In one of the orders belonging to this group—the Marsupialia—the female is furnished with a pouch (marsupium), in which the young mammal passes its long infancy. In the other—Monotremata—although the mammary glands are well developed, yet the orifices of these glands are not elevated into nipples.

Though most young animals are born in a helpless condition, yet many interesting differences in the degree of this helplessness are to be observed. Some, like most of the rodents (rabbits, rats, &c.) and carnivores (cats, dogs, lion), are blind, and incapable of much motion for some days after their birth; while others (horse, some ruminants) are almost at once capable of locomotion, and evince by every movement that they are full of life. The length of time taken to arrive at an adult stage varies much. The guinea-pig seems mature at two months, while other animals take twice as many years.

The class of the Mammalia may be divided into the following orders and sub-orders:—

1. Primates	Anthropoidea. Lemuroidea.
2. Cheiroptera	Megacheiroptera. Microcheiroptera.
3. Insectivora.	
4. Carnivora	Fissipedia. Pinnipedia.
5. Cetacea	Mystaceti. Odontoceti.
6. Sirenia	
7. Ungulata	Perissodactyla. Artiodactyla.
8. Proboscidea.	
9. Hyracoidea.	
10. Rodentia	Simplicidentata Duplicidentata.
11. Edentata.	
12. Marsupialia.	
13. Monotremata.	

ORDER I.—PRIMATES.



THIS order is so called as it contains the first and highest of all the Mammals. It most naturally divides itself into two chief groups, or sub-orders—that called Anthropoidea, in which the forms are human, or more or less resemble the human form; and that called Lemuroidea, which contains the Lemurs and other allied forms. In this work we omit all reference to the highest and most gifted of all the families of Mammalia, that containing but a single genus and species—Man. Some, indeed, think it preferable to remove man as a family from the Primates, and place him by himself, as an order—Bimana; and then the rest of the primates will fall into an order called Quadrumana. Treating the subject from the Natural History point of view, it makes but little matter which view is adopted. In our enumeration of the families, we exclude that of the human species, and we commence with an account of the several families of the Anthropoid, or man-like Monkeys. These have all got incisor, canine, and molar teeth—the latter have the enamel equally distributed, and are either ten or twelve in each jaw. The canines are distinct, longer than the incisors—which latter are four in number in both jaws. The feet are either all five-fingered, or only the posterior ones, with the anterior four-fingered, wanting the thumb. In those with all the feet five-fingered, the big finger on each foot is remote from the others; the nail is generally flat, and from their being able to oppose this big finger to the other fingers, so as to enable the feet to be as prehensile as the hands, the name Quadrumana, or four-handed, is often given to these monkeys.

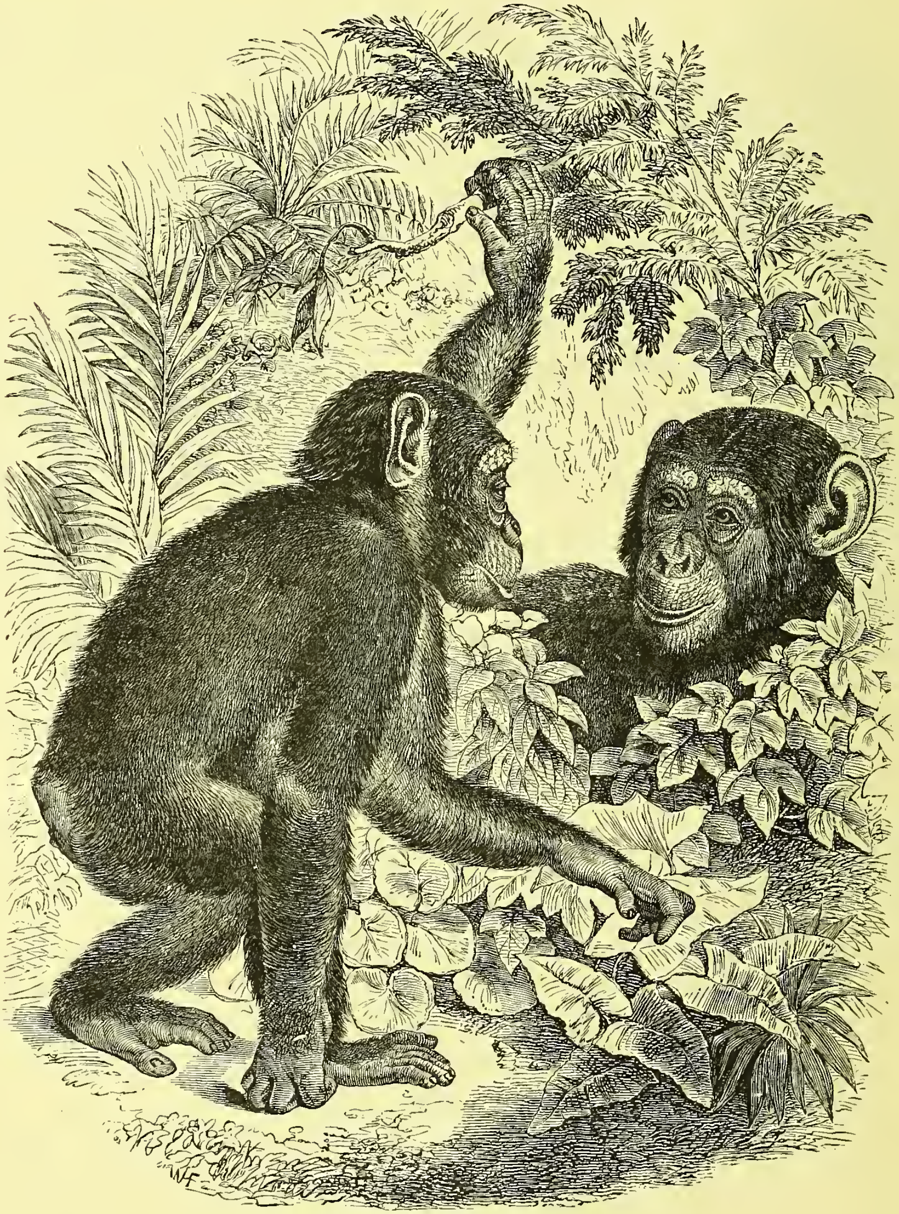
SUB-ORDER 1.—MAN-SHAPED ANIMALS (*Anthropoidea*).

FAMILY I.—THE APES (*Simiidæ*).

THE first family on our list of Mammalia contains those species of monkeys which, in general organisation, approach nearest to man. These inhabit the tropics of the Old World, being most abundant near the Equator, and each of the genera seem to have a well-marked geographical area. There are but four genera and twelve species at present known.

The genus Troglodytes contains two species—the Chimpanzee and the Gorilla. Both of these are only to be met with in a comparatively small district of West Africa, being found on that coast, not above 12° north or south of the Equator, with an inland range that is not at present defined. Perhaps there may be other species not yet discovered, as Dr. Livingstone in his last Journal would seem to indicate that a new species was met with on the shores of Lake Tanganyika.

The Chimpanzee (*Troglodytes niger*) has a somewhat more extended range than the gorilla, and it is at the present very rarely found on the coast, being driven further and further inland. Specimens however are still found at the mouth of the River Congo; and Mr. Monteiro, in forwarding a few years since (1871) a young male to the London Zoological Gardens, wrote:—"The chimpanzee was purchased from the blacks at Poanana, at the mouth of the Congo. Its exact place of capture I am unable to give; but while it inhabits the north bank of the river, it seems to be quite unknown on its southern shores." During the last ten years more than twenty specimens have reached these Gardens, but the climate of this country does not seem to agree with them, and they have all been short-lived. The adult chimpanzee is about five feet in height. Dr. Trail, describing a young female from the Gaboon, says:—"The skin appears of a yellowish-white colour, and is thinly covered with long black hair in front, but it is considerably more hairy behind. The hair on the head is rather thin; it is thickest on the forehead, and forms whiskers on the cheeks. There are a few stiff black hairs on the eyebrows, and it has a scanty eyelash. A few whitish hairs are scattered over the lips, especially on the under one. The rest of the face is naked, and has a whitish and wrinkled skin. The hair is somewhat bushy on the back. The longest hair is just at the elbows. There is none on the fingers or palms of either extremities. The ears are remarkably prominent, thin, and naked. The nose is quite flat, or, rather, appears only as a wrinkle of the skin, with a slight depression along its centre. The nostrils open upwards, which would be inconvenient did the creature usually assume the upright position. The projection of the jaws is excessive. The mouth is wide, the lips rather



THE CHIMPANZEE (*Troglodytes niger*).

thin, and destitute of that recurvation of their edges which adds so much to the expression of the human countenance. The spread of the shoulders is distinctly marked. From the lower ribs the body decreases rapidly to the loins. The thumb is by far the smallest of the fingers. The foot strongly resembles a hand. The thumb of this part is very long, powerful, and may be greatly extended."

They seek a mountainous tract of country, with numerous intervening valleys. In these regions the heights are covered to the summits with lofty forests, giving to the distant scenery a rich and romantic appearance. The edible fruits are numerous and luscious, including the pine-apple. Rice-fields also abound, these being usually intermixed with various fruit-trees. Among these is the plantain, which rises to the height of ten to fifteen feet, and yields a fruit eight or nine inches long, about an inch in diameter, bent slightly on one side, which turns black or yellow as it ripens, and when mature is filled with a pulp of a luscious sweet taste. A cluster produced on a single plant often contains from sixty to one hundred fruits, weighing from seventy to eighty pounds.

In Sierra Leone they generally take up their abode near some deserted town or village, where the papaw-tree grows in abundance, of the fruit of which they are very fond. They are said to build huts nearly in the form of those reared by the natives, and cover them with leaves; but this may be doubted.

It was thought by Lieutenant Sayers, who brought a young chimpanzee to England, which he had procured in the Bullom country, where its mother had been shot, that these animals climb trees only for food or observation. From the natives he learned that they do not reach their full growth till between nine and ten years of age. Their height, at maturity, is said to be between four and five feet; and he mentions one as brought from Free Town, which was so heavy as to form a fair load for two men, who carried him on a pole between them.

The natives say that the chimpanzees in their wild state have been seen to snap boughs off the trees, which two men united could scarcely bend, with the greatest apparent ease. When Lieutenant Sayers visited the rice-farms of a chief on the Bullom shore, their cries plainly indicated the presence of a troop, as the noise could not have been produced by less than eight or ten of them. The natives also affirmed that they always travel in strong bodies, armed with sticks, which they use with great dexterity. They are exceedingly watchful, and the first one which discovers the approach of a stranger utters a protracted cry, strongly resembling that of a human being in the greatest distress.

The Gorilla (*Troglodytes gorilla*) is the largest of the apes, attaining a height of about six feet. It is confined to the same geographical area as the chimpanzee, but within narrower limits on and near the Equator. It is now upwards of two thousand five hundred years ago since Hanno, a navigator, set sail from Carthage, a city then situated in a commanding spot, just where the African coast juts out into the blue waters of the Mediterranean, and approaches nearest to the opposite coast of Sicily, the largest and finest island of that inland sea. He was sent out by his countrymen on no ordinary enterprise at that period, for he was charged to proceed beyond the Pillars of Hercules, or Straits of Gibraltar, with a fleet of sixty vessels, and with thirty thousand persons, both men and women, on board, for the purpose of establishing colonies on the western coast of Africa.

Arranging for the settlement of some towns as they advanced, they reached a great bay, to which they gave the name of the "Western Horn." In this bay was an island, on which they landed, to obtain a brief repose after enduring the hardships of the sea. During the day all was calm, but at night strange appearances presented themselves: the mountains seemed to be all on fire, and the sound as of flutes, drums, and cymbals was mingled with wild screams and piercing cries. Terrified at what they saw and heard, they, as speedily as possible, took flight. As they continued their cruise to the south, the odoriferous plants of the coast perfumed the air; but still columns of flame seemed to illuminate the midnight sky, and the ground was so hot that it was impossible to walk on it for a moderate distance.

Passing the streams of fire, they came to a bay called the Horn of the South. In the recess there was an island like the first, having a lake, and in this there was another island full of wild creatures; much the greater part of them were females, with hairy bodies, whom the interpreters called "Gorillas." Pursuing them, they were not able to take the males; they all escaped, being able to climb the precipices, and defend themselves with pieces of rock. Three females, who bit and scratched those who led them, were taken, but would not come quietly: so having killed and flayed them, they conveyed the skins to Carthage; for they did not sail any further, as provisions began to fail. This encounter indicates, therefore, the southernmost point on the west coast of Africa reached by the Carthaginian navigator.

Though the size and form of the creature thus beheld "would suggest to Hanno and his crew," as Professor Owen remarks, "no other idea of its nature than that of a kind of human being, yet the climbing faculty, the hairy body, and the skinning of the dead specimens, strongly suggest that they were great apes. The fact that apes, somewhat resembling the negroes, of human size, and with hairy bodies, still exist on the west coast of Africa, renders it highly probable that such were the creatures which Hanno saw, captured, and called 'Gorullai.'"

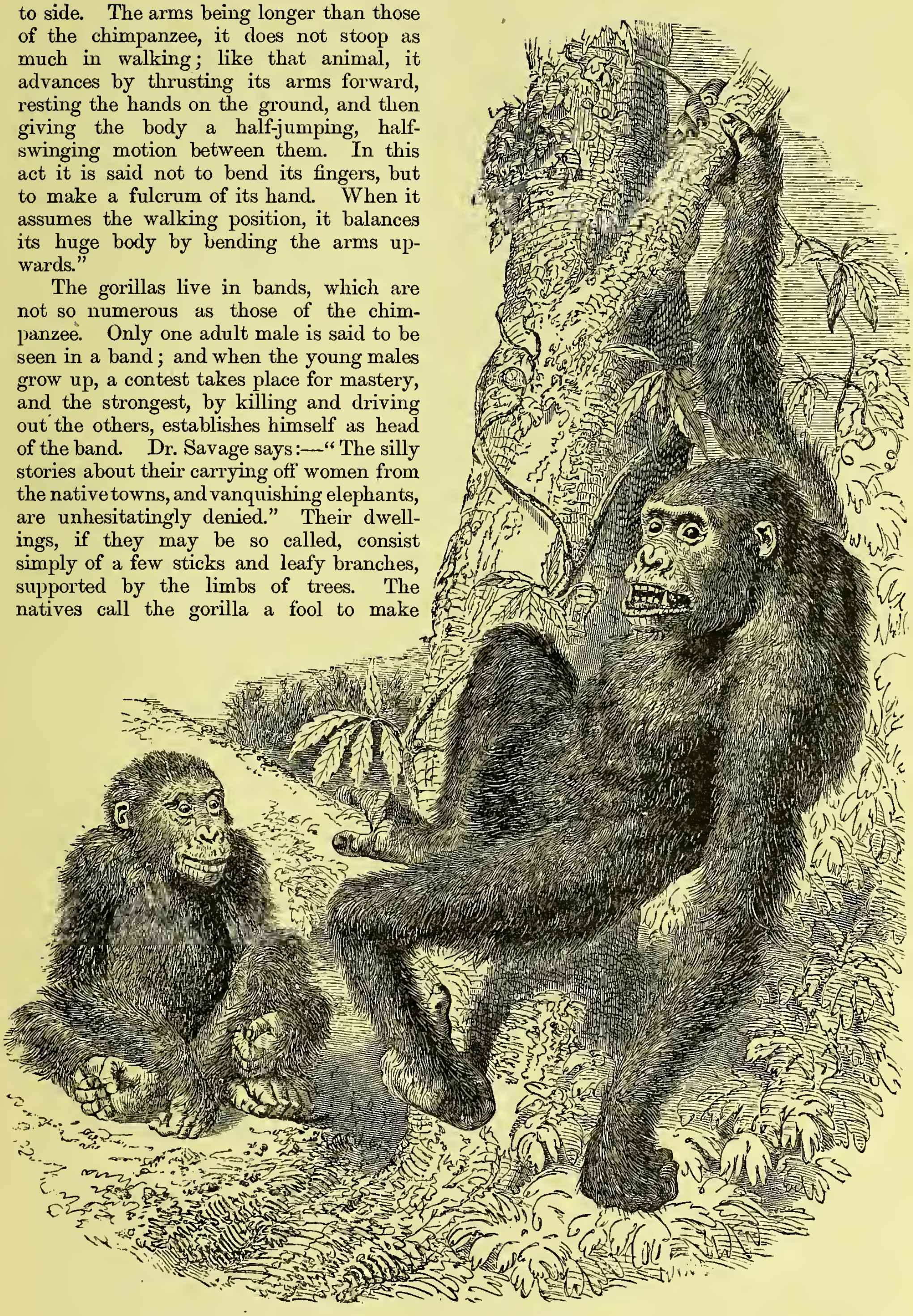
Battell, an English sailor, while a prisoner of the Portuguese (1590), in Angola, speaks, it is believed, of the same creature, which, he says, is called Pongo, and of which he seems to have entertained precisely similar notions.

Of these creatures nothing further was heard, until attention was directed to them by Dr. Thomas S. Savage, a member of the Boston Society of Natural History, and at the time a medical missionary. On his voyage to America from Cape Palmas, he was unexpectedly detained on the Gaboon river, and spent the month of April, 1847, at the house of the Rev. J. L. Wilson, senior missionary of the American Board of Foreign Missions to West Africa. Soon after his arrival, Mr. Wilson showed him a skull, represented by the natives to be that of a monkey-like animal, remarkable for it size, ferocity, and habits; and the doctor was led to believe that it belonged to a new species of orang. Intent on further investigation, and, if possible, on deciding the point by the inspection of a specimen, alive or dead, Mr. Wilson entered cordially into the matter, and promised his full co-operation; and having been a resident in the country for several years, well acquainted with the chiefs and people, highly regarded by them, and speaking freely their language, he was enabled to obtain several skulls of the two sexes, and of different ages, with other important parts of the skeleton of the gorilla. These portions were afterwards ably described, with several engravings, on the return of Dr. Savage to America, by Dr. Wyman, Professor of Anatomy in Harvard University.

Of this creature Professor Owen has recently given a full and most elaborate description, from which only a few particulars can now be taken. The lofty ridges of the skull, he affirms, give to the face of the gorilla a most forbidding appearance, the thick covering forming a scowling pent-house over the eyes. The nose is more prominent than in the chimpanzee or orang-utan. The mouth is very wide, the lips large, of uniform thickness, and the chin very short and receding. The huge canine teeth in the male are most formidable. The eyelids have eyelashes, but there are no eyebrows; the ears are smaller in proportion than in man, and much smaller than in the chimpanzee. The length of the upper limbs is not greater than in man when compared with the trunk; they seem longer through the disproportionate shortness of the lower limbs. The arm is longer than the fore-arm, which is remarkable, and the thumb reaches to beyond the first joint of the forefinger, while it does not extend to that joint in the chimpanzee or other ape. The hand excites attention, from the breadth, thickness, and great length of the palm; the fingers appear short, taper quickly at the ends to the nails, which are not larger or longer than in man. The back of the hand is hairy as far as the divisions of the fingers, the palm naked and callous, and the thumb scarcely half as thick as the forefinger. The leg has no "calf," and grows thicker from the knee to the ankle. The sole of the foot is more walked upon than by the chimpanzee, or any other ape. The hind thumb, or great toe, is stronger than in those creatures: it stands out like a large thumb from the rest of the foot; its base swells below into a kind of ball; the nail is small and short. The sole is wider than in man; the foot more like a hand, but one of huge dimensions and immense power of grasp. And yet the gorilla, judging from the structure of his grinding teeth, lives on fruits.

Dr. Savage says:—"The gait of the gorilla is shuffling; the motion of the body—which is never upright as in man, but bent forward—is somewhat rolling, or from side to side. The arms being longer than those of the chimpanzee, it does not stoop as much in walking; like that animal, it advances by thrusting its arms forward, resting the hands on the ground, and then giving the body a half-jumping, half-swinging motion between them. In this act it is said not to bend its fingers, but to make a fulcrum of its hand. When it assumes the walking position, it balances its huge body by bending the arms upwards."

The gorillas live in bands, which are not so numerous as those of the chimpanzee. Only one adult male is said to be seen in a band; and when the young males grow up, a contest takes place for mastery, and the strongest, by killing and driving out the others, establishes himself as head of the band. Dr. Savage says:—"The silly stories about their carrying off women from the native towns, and vanquishing elephants, are unhesitatingly denied." Their dwellings, if they may be so called, consist simply of a few sticks and leafy branches, supported by the limbs of trees. The natives call the gorilla a fool to make



THE GORILLA (*Troglodytes Gorilla*).

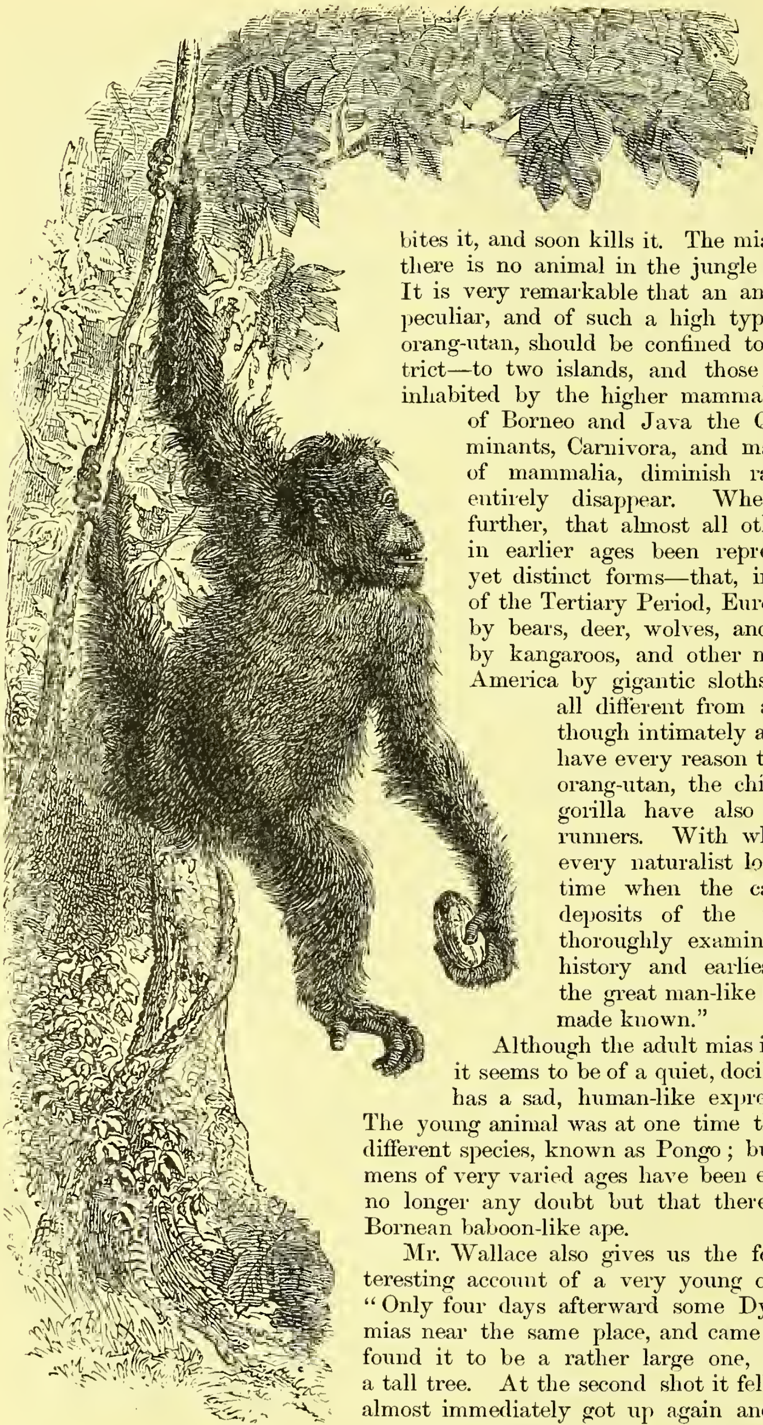
a house without a roof, in a country where they have so much rain. They say he has not so much sense as a certain bird, which Mr. Wilson pointed out to Dr. Savage, which makes a large nest with a tight roof, then daubs it with mud in the inside, and, unfolding its wings, whirls round and round till the crevices are all filled, and the inside is smoothly plastered like a house. The huts of the gorilla are only occupied at night. These animals are exceedingly ferocious. The few that have been taken have been killed by elephant hunters and native traders, as they came suddenly upon them while passing through the forests.

When the male is first seen he gives a terrific yell, that resounds far and wide through the forest, something like *Kh—ah! Kh—ah!* prolonged and shrill. His enormous jaws are widely opened at each expiration, his under lip hangs over the chin, and the hairy ridge and scalp is contracted on the brow. The females and young disappear at the first cry. He then approaches the foe, pouring out in quick succession his horrid yells. The hunter waits his advance with his gun extended; if his aim is not sure, he permits the animal to grasp the barrel, and as he carries it to his mouth, according to his habit, the hunter fires; should the gun fail to go off, and it is an ordinary musket, the thin barrel is crushed between the teeth of the gorilla, and the hunter perishes.

The genus Simia apparently contains but a single species, and to meet with it we have to pass from Africa—the abode of the Troglodytes—to the Indo-Malayan region, where, in the northern part of Sumatra, and in Borneo, the Orang-utan, or Mias (*Simia Satyrus*), is found. "There is every reason to believe," writes Mr. Wallace, "that it is confined to these two great islands, in the former of which, however, it seems to be much more rare. In Borneo it has a wide range, inhabiting many districts on the south-west, south-east, north-east, and north-west coasts; but appears to be chiefly confined to the low and swampy forests. It seems, at first sight, very inexplicable that the mias should be quite unknown in the Saráwak Valley, while it is abundant in Sambas, on the west, and Sadong, on the east. But when we know the habits and mode of life of the animal, we see a sufficient reason for this apparent anomaly in the physical features of the Saráwak district. In the Sadong, where I observed it, the mias is only found when the country is low, level, and swampy, and at the same time covered with a lofty virgin forest. From these swamps rise many isolated mountains, on some of which the Dyaks have settled, and covered with plantations of fruit-trees. These are a great attraction to the mias, which comes to feed on the unripe fruits, but always retires to the swamp at night. Where the country becomes slightly elevated, and the soil dry, the mias is no longer to be found. For example: in all the lower part of the Sadong valley it abounds, but as soon as we ascend above the limits of the tides, where the country, though still flat, is high enough to be dry, it disappears. Now the Saráwak Valley has this peculiarity—the lower portion, though swampy, is not covered with continuous lofty forest, but is principally occupied by the Nissa palm; and near the town of Saráwak, where the country becomes dry, it is greatly undulated in many parts, and covered with small patches of virgin forest and much second-growth jungle, on ground which has once been cultivated by the Malays or Dyaks. Now it seems to me probable that a wide extent of unbroken and equally lofty virgin forest is necessary to the comfortable existence of these animals. Such forests form their open country, where they can roam in every direction with as much facility as the Indian on the prairie or the Arab on the desert, passing from tree-top to tree-top without ever being obliged to descend upon the earth. The elevated and the drier districts are more frequented by man, more cut up by clearings and low second-growth jungle, not adapted to its peculiar mode of progression, and where it would, therefore, be more exposed to danger, and more frequently obliged to descend upon the earth. There is, probably, also a greater variety of fruit in the mias district, the small mountains, which rise like islands out of it, serving as a sort of gardens or plantations, where the trees of the uplands are to be found in the very midst of the swampy plains. It is a singular and very interesting sight to watch a mias making his way leisurely through the forest. He walks deliberately along some of the larger branches, in the semi-erect attitude which the great length of his arms and the shortness of his legs cause him naturally to assume; and the disproportion between these limbs is increased by his walking on his knuckles, not on the palm of the hand, as we should do. He seems always to choose those branches which intermingle with an adjoining tree, on approaching which he stretches out his long arms, and seizing the opposing boughs, grasps them together with both hands, seems to try their strength, and then deliberately swings himself across to the next branch, on which he walks along as before. He never jumps or springs, or even appears to hurry himself, and yet manages to get along almost as quickly as a person can run through the forest beneath. The long and powerful arms are of the greatest use to the animal, enabling it to climb easily up the loftiest trees, to seize fruits and young leaves from slender boughs which will not bear its weight, and to gather leaves and branches with which to form its nest. I have already described how it forms a nest when wounded, but it uses a similar one to sleep in almost every night. This is placed low down, however, on a small tree, not more than from twenty to fifty feet from the ground, probably because it is warmer and less exposed to wind than higher up. Each mias is said to make a fresh one for himself every night; but I should think that it is hardly probable, or their remains would be much more abundant, for though I saw several about the coal-mines, there must have been many orangs about every day, and in a year their deserted nests would become very numerous. The Dyaks say that when it is very wet the mias covers himself over with leaves of pandanus, or large ferns, which has perhaps led to the story of his making a hut in the trees. The orang does not leave his bed till the sun has well risen, and has dried up the dew upon the leaves. He feeds all through the middle of the day, but seldom returns to the same tree two days running. They do not seem much alarmed at man, as they often stared down upon me for several minutes, and then only moved away slowly to an adjacent tree. After seeing one, I have often had to go half a mile or more to fetch my gun, and in nearly every case have found it on the same tree, or within a hundred yards, when I returned. I never saw two full-grown animals together, but both males and females are sometimes accompanied by half-grown young ones, while at other times three or four young ones were seen in company. Their food consists almost exclusively of fruit, with occasionally leaves, buds, and young shoots. They seem to prefer unripe fruits, some of which were very sour, others intensely bitter, particularly the large, red, fleshy arillus of one which seemed an especial favourite. In other cases they eat only the small seed of a large fruit, and they almost always waste and destroy more than they eat, so that there is a continual rain of rejected portions below the tree they are feeding on. The durian is an especial favourite, and quantities of this delicious fruit are destroyed wherever it grows surrounded by forest, but they will not cross clearings to get at them. It seems wonderful how the animal can tear open this fruit, the outer covering of which is so thick and tough, and closely covered with strong conical spines. It probably bites off a few of these first, and then, making a small hole, tears open the fruit with its powerful fingers. The mias rarely descends to the ground, except, when pressed by hunger it seeks for succulent shoots by the river side; or, in very dry weather, has to search after water, of which it generally finds sufficient in the hollows of leaves. Once only I saw two half-grown orangs on the ground, in a dry hollow at the foot of the Simūnjon Hill. They were playing together, standing erect, and grasping each other by the arms. It may be safely stated, however, that the orang never walks erect, unless when using its hands to support itself by branches overhead, or when attacked. Representations of its walking with a stick are entirely imaginary. The Dyaks all declare that the mias is never attacked by any animal in the forest, with two rare exceptions; and the accounts I received of these are so curious that I give them nearly in the words of my informants, old Dyak chiefs, who had lived all their lives in the places where the animal is most abundant. The first of whom I inquired said, 'No animal is strong enough to hurt the mias, and the only creature he ever fights with is the crocodile. When there is no fruit in the jungle he goes to seek food on the banks of the river, where there are plenty of young shoots that he likes, and fruits that grow close to the water. Then the crocodile sometimes tries to seize him, but the mias gets upon him, and beats him with his hands and feet, and tears him and kills him.' He added that he had once seen such a fight, and that he believes that the mias is always the victor. My next informant was the Orang Kaya, or chief of the Balow Dyaks, on the Simūnjon River. He said:—'The mias has no enemies; no animals dare attack it but the crocodile and the python. He always kills the crocodile by main strength, standing upon it, pulling open its jaws, and ripping up its throat. If a python attacks a mias, he seizes it with his hands, and then bites it, and soon kills it. The mias is very strong; there is no animal in the jungle so strong as he.' It is very remarkable that an animal so large, so peculiar, and of such a high type of form as the orang-utan, should be confined to so limited a district—to two islands, and those almost the last inhabited by the higher mammalia; for eastward of Borneo and Java the Quadrumana, Ruminants, Carnivora, and many other groups of mammalia, diminish rapidly, and soon entirely disappear. When we consider, further, that almost all other animals have in earlier ages been represented by allied yet distinct forms—that, in the latter part of the Tertiary Period, Europe was inhabited by bears, deer, wolves, and cats; Australia by kangaroos, and other marsupials; South America by gigantic sloths and ant-eaters; all different from any now existing, though intimately allied to them—we have every reason to believe that the orang-utan, the chimpanzee, and the gorilla have also had their forerunners. With what interest must every naturalist look forward to the time when the caves and tertiary deposits of the tropics may be thoroughly examined, and the past history and earliest appearance of the great man-like apes be at length made known."

Although the adult mias is a strong animal, it seems to be of a quiet, docile disposition, and has a sad, human-like expression of features. The young animal was at one time thought to form a different species, known as Pongo; but now that specimens of very varied ages have been examined, there is no longer any doubt but that there is only the one Bornean baboon-like ape.

Mr. Wallace also gives us the following most interesting account of a very young orang, or mias:— "Only four days afterward some Dyaks saw another mias near the same place, and came to tell me. We found it to be a rather large one, very high up on a tall tree. At the second shot it fell rolling over, but almost immediately got up again and began to climb. At a third shot it fell dead. This was a full-grown female, and while preparing to carry it home we found a young one, face downwards, in the bog. The little creature was only about a foot long, and had evidently been hanging to its mother when she



THE ORANG (*Simia Satyrus*).

first fell. Luckily, it did not appear to have been wounded, and after we had cleaned the mud out of its mouth, it began to cry out, and seemed quite strong and active. While carrying it home it got its hands in my beard, and grasped so tightly that I had great difficulty in getting free, for the fingers are habitually bent inwards at the last joint so as to form complete hooks. At this time it had not a single tooth, but a few days afterwards it cut its two lower front teeth. Unfortunately, I had no milk to give it, as neither Malays, Chinese, nor Dyaks ever use the article, and I in vain inquired for any female animal that could suckle my little infant. I was therefore obliged to give it rice-water from a bottle with a quill in the cork, which, after a few trials, it learned to suck very well. This was very meagre diet, and the little creature did not thrive well on it, although I added sugar and cocoa-nut milk occasionally, to make it more nourishing. When I put my finger in its mouth it sucked with great vigour, drawing in its cheeks with all its might in the vain effort to extract some milk, and only after persevering a long time would it give up in disgust, and set up a scream, very like that of a baby in similar circumstances. When handled or nursed it was very quiet and contented, but when laid down by itself would invariably cry, and for the first few nights was very restless and noisy. I fitted up a little box for a cradle, with a soft mat for it to lie upon, which was changed and washed every day; and I soon found it necessary to wash the little mias as well. After I had done so a few times, it came to like the operation, and as soon as it was dirty would begin crying, and not leave off till I took it out and carried it to the spout, when it immediately became quiet, although it would wince a little at the first rush of the cold water, and make ridiculously wry faces while the stream was running over its head. It enjoyed the wiping and rubbing dry amazingly, and when I brushed its hair seemed to be perfectly happy, lying quite still, with its arms and legs stretched out, while I thoroughly brushed the long hair of its back and arms. For the first few days it clung desperately with all four hands to whatever it could lay hold of; and I had to be careful to keep my beard out of its way, as its fingers clutched hold of hair more tenaciously than anything else, and it was impossible to free myself without assistance. When restless it would struggle about, with its hands up in the air, trying to find something to take hold of; and when it had got a bit of stick or rag in two or three of its hands seemed quite happy. For want of something else, it would often seize its own feet, and after a time it would constantly cross its arms, and grasp with each hand the long hair that grew just below the opposite shoulder. The great tenacity of its grasp soon diminished, and I was obliged to invent some means to give it exercise and strengthen its limbs. For this purpose I made a short ladder of three or four rounds, on which I put it to hang for a quarter of an hour at a time. At first it seemed much pleased, but it could not get all four hands in a comfortable position, and, after changing about several times, would leave hold of one hand after the other, and drop on to the floor. Sometimes when hanging only by two hands, it would loose one, and cross it to the opposite shoulder, grasping its own hair; and as this seemed much more agreeable than the stick, it would then loose the other and tumble down, when it would cross both, and lie on its back quite contentedly, never seeming to be hurt by its numerous tumbles. Finding it so fond of hair, I endeavoured to make an artificial mother, by wrapping up a piece of buffalo-skin into a bundle, and suspending it about a foot from the floor. At first this seemed to suit it admirably, as it could sprawl its legs about, and always find some hair, which it grasped with the greatest tenacity. I was now in hopes that I had made the little orphan quite happy; and so it seemed for some time, till it began to pull itself up close to the skin, and try about everywhere for a likely place; but as it only succeeded in getting mouthfuls of hair and wool, it would be greatly disgusted, and scream violently, and after two or three attempts let go altogether. One day it got some wool into its throat, and I thought it would have choked, but after much gasping it recovered, and I was obliged to take the imitation mother to pieces again, and give up this last attempt to exercise the little creature.

"After the first week I found I could feed it better with a spoon, and give it a little more varied and more solid food. Well-soaked biscuit, mixed with a little egg and sugar, and sometimes sweet potatoes, were readily eaten; and it was a never-failing amusement to observe the curious changes of countenance by which it would express its approval or dislike of what was given to it. The poor little thing would lick its lips, draw in its cheeks, and turn up its eyes with an expression of the most supreme satisfaction when it had a mouthful particularly to its taste. On the other hand, when its food was not sufficiently sweet or palatable, it would turn the mouthful about with its tongue for a moment, as if trying to extract what flavour there was, and then push it all out between its lips. If the same food was continued, it would set up a scream, and kick about violently, exactly like a baby in a passion. After I had had the little mias about three weeks, I fortunately obtained a young hare-lip monkey (*Macacus cynomolgus*), which, though small, was very active, and could feed itself. I placed it in the same box with the mias, and they immediately became excellent friends, neither exhibiting the least fear of the other. The little monkey would sit upon the other's stomach, or even on its face, without the least regard to its feelings. While I was feeding the mias, the monkey would sit by, picking up all that was spilt, and occasionally putting out its hands to intercept the spoon; and as soon as I had finished would pick off what was left sticking to the mias' lips, and then pull open its mouth, and see if any still remained inside, afterwards lying down on the poor creature's stomach as on a comfortable cushion. The little helpless mias would submit to all these insults with the most exemplary patience, only too glad to have something warm near it, which it could clasp affectionately in its arms. It sometimes, however, had its revenge; for when the monkey wanted to go away, the mias would hold on as it could by the loose skin of its back or head, or by its tail, and it was only after many vigorous jumps that the monkey could make his escape. It was curious to observe the different actions of these two animals, which could not have differed much in age. The mias, like a very young baby, lying on its back, quite helpless, rolling lazily from side to side, stretching out all four hands into the air, wishing to grasp something, but hardly able to guide its fingers to any definite object; and when dissatisfied, opening wide its almost toothless mouth, and expressing its wants by a most infantine scream. The little monkey, on the other hand, in constant motion: running and jumping about wherever it pleased, examining everything around it, seizing hold of the smallest objects with the greatest precision, balancing itself on the edge of the box, or running up a post, and helping itself to anything eatable that came in its way. There could hardly be a greater contrast; and the baby mias looked more baby-like by the comparison. When I had had it about a month, it began to exhibit some signs of learning to run alone. When laid upon the floor it would push itself along by its legs, or roll itself over, and thus make an unwieldy progression. When lying in the box it would lift itself up to the edge into almost an erect position, and once or twice succeeded in tumbling out. When left dirty, or hungry, or otherwise neglected, it would scream violently till attended to, varied by a kind of coughing or pumping noise, very similar to that which is made by the adult animal. If no one was in the house, or its cries were not attended to, it would be quiet after a little while, but the moment it heard a footstep would begin again harder than ever. After five weeks it cut its two upper front teeth, but in all this time it had not grown the least bit, remaining, both in size and weight, the same as when I first procured it. This was, no doubt, owing to the want of milk or other equally nourishing food. Rice-water, rice, and biscuits were but a poor substitute, and the expressed milk of the cocoa-nut, which I sometimes gave it, did not quite agree with its stomach. To this I imputed an attack of diarrhœa, from which the poor little creature suffered greatly, but a small dose of castor-oil operated well and cured it. A week or two afterwards it was again taken ill, and this time more seriously. The symptoms were exactly those of intermittent fever, accompanied by watery swellings on the feet and head. It lost all appetite for its food, and, after lingering for a week a most pitiable object, died, after being in my possession nearly three months. I much regretted the loss of my little pet, which I had at one time looked forward to bringing up to years of maturity, and taking home to England. For several months it had afforded me daily amusement by its curious ways and the inimitably ludicrous expression of its little countenance. Its weight was three pounds nine ounces, its height fourteen inches, and the spread of its arms twenty-three inches. I preserved its skin and skeleton, and, in doing so, found that when it fell from the tree it must have broken an arm and a leg, which had, however, united so rapidly that I had only noticed the hard swellings on the limbs where the irregular junction of the bones had taken place."

The third genus is that of Hylobates, which contains several species. These are generally known as the Gibbons, or long-armed apes. They live in troops on the tops of trees, in upland districts, and are noted for their loud single-noted cry, which they raise about sunrise. The following species are known:—H. hoolock (Assam); H. lar (Malay Peninsula); H. leuciscus (Java); H. agilis (Sumatra); H. concolor (Borneo); H. pileatus (Cambodia, Hainan). The name of Hylobates is given to this group from the power they possess of walking nearly erect.

The first species in our list is, perhaps, the best known. The Hoolock is a native of Assam, often found in the neighbourhood of Goalpara, situated on the Brahmaputra river. The colour of the young, according to Dr. Harlan, is blackish-brown, sprinkled with grey on the hands and feet; a tuft of grey extends along the middle of the front of the body; and the band of grey over the eyes of the adult is generally interrupted in the middle of the forehead by a line of black hairs, which is absent in the young one. In the young animal the fore-arm is shorter than the arm, a fact at variance with the proportions of those parts, not only in the orangs, but in most adult apes. In the adult the arm and fore-arm are within one inch and two-tenths of being equal in length. The length of the canine teeth is also remarkable. These animals inhabit, more particularly, the lower hills, not being able to endure the cold of those ranges of the Garrows of more than a few hundred feet elevation. In the wild state their food consists chiefly of fruits common to the jungles of this part of India. When placed on a floor, or in an open field, they balance themselves nicely, by raising their hands over their heads, and slightly bending the arm at the wrist and elbow, and then run tolerably fast, rocking from side to side. If urged to greater speed, they let fall their hands to the ground, and assist themselves forward, rather jumping than running. If they succeed in making their way to a grove of trees, they then swing with such astonishing rapidity from branch to branch, and from tree to tree, that they are soon lost in the jungle or forest.

THE HOOLOCK GIBBON (*Hylobates hoolock*).

Dr. Burrough, during an excursion into the interior of Bengal, had one presented to him by Captain Davidson. He became so tame and manageable in less than a month, that he would take hold of the doctor's hand, and walk with him, helping himself along with the other hand applied to the ground. He would come at his call, seat himself on a chair by his side at the breakfast-table, and help himself to an egg or the wing of a chicken, without endangering any of the table furniture. He would partake of coffee, chocolate, milk, and tea; and, although his usual mode of taking liquids was by dipping his knuckles into the cup and licking his fingers, still, when apparently more thirsty, he would take up the vessel from which he was fed with both hands, and drink like a man from a spring. His principal food consisted of boiled bread and milk, boiled rice, with sugar, plantains, bananas, oranges, and other fruits, all of which he ate, but seemed best pleased with bananas. He was fond of insects, would search in the crevices of the house for spiders, and if a fly chanced to come within reach, he would dexterously catch him with one hand, the right being that generally employed.

"In temper," says Dr. Burrough, "he was remarkably pacific, and seemed, as I thought, often glad to have an opportunity of testifying his affection and attachment to me. When I visited him in the morning, he would commence a loud, shrill *Whoo—whoo—whoo!* which he would often keep up for from five to ten minutes, with an occasional intermission for the purpose of taking a full respiration, until finally, apparently quite exhausted, he would lie down, and allow me to comb his head and brush the long hair on his arms, and seemed delighted by the tickling sensation produced by the brush on his belly and legs. He would turn from side to side, first hold out one arm and then the other, and when I attempted to go away, he would catch hold of my arm or coat-tail, and pull me back again to renew any little attention to him daily bestowed. If I called him from a distance, and he could recognise my voice, he would at once set up his usual cry, which he sometimes brought down gradually to a kind of moan, but generally resumed his louder tone when I approached him."

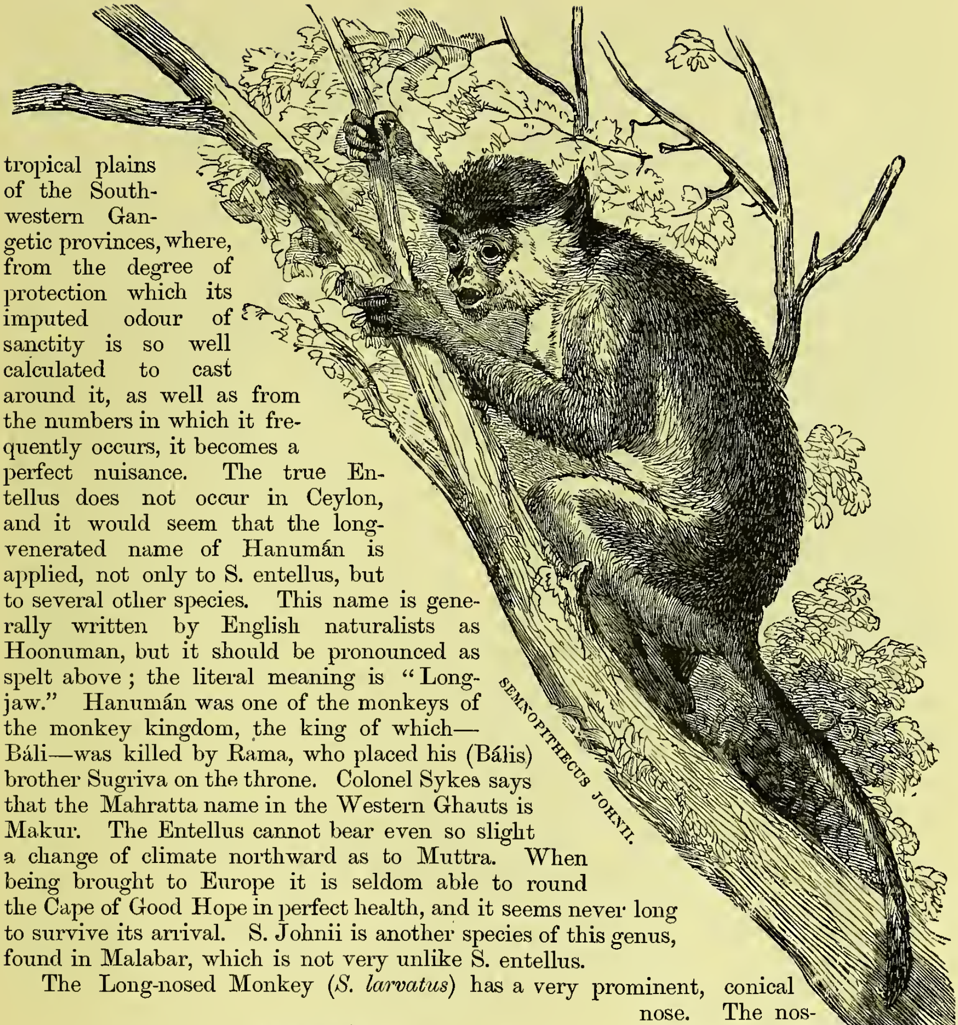
Siamanga is the last genus of the Simiidæ; it contains but a single species, S. syndactyla. The Siamang has been separated from the other long-armed apes on account of the curious formation of the feet; these have the second and third toes closely united as far as the middle of the second phalanx. It is upwards of three feet in height, and somewhat muscular and robust. The molar teeth have tubercles, like those observable among the apes. Its colour is black, without a white circle about the face, and it has two loose naked folds of skin on the throat, which are occasionally inflated. The hair of the head and body is long and soft, but the face is without any. The nose is flat and depressed above, but rises below abruptly with a cartilaginous eminence, in which the large, nearly circular, nostrils are pierced from the sides in an oblique direction; at its extremity this eminence is obtuse, and is united to the upper lip by a narrow gradually attenuated apex, which, forming a cartilaginous arch, gives the Siamang a peculiar appearance. The orbits of the eyes are circular and remarkably prominent, and the canine teeth are long.

These animals are common in Sumatra and Java. They generally assemble in large troops, conducted, the natives say, by a chief, whom they deem to be invulnerable. Thus assembled at sunrise, and again at sunset, they vie with one another in making the most dreadful cries, perfectly stunning to those unaccustomed to them, and alarming in the highest degree to strangers.

A Siamang, called by the Malays at Singapore Ungka, was obtained there by Mr. George Bennett, who has given a most minute description of it in his "Wanderings." On entering the yard in which Ungka was tied up one morning, Mr. Bennett was not well pleased at observing him busily engaged in removing his belt, to which the cord or chain was fixed (which, as he afterwards understood, had been loosened on purpose). The animal, meanwhile, was whining and uttering a peculiar squeaking noise. As soon as he had succeeded in procuring his liberty, he walked, in his usual erect position, towards some Malays who were standing near the place, hugging the legs of several of the party, but without permitting them to take him in their arms. He now went to a Malay lad, who seemed to be the object of his search, for, on meeting with him, he immediately climbed into his arms, and hugged him closely, expressing, both by look and manner, his gratification at being once more with him, whom Mr. Bennett now understood to have been his former master.

FAMILY II.—THE SACRED MONKEYS (*Semnopithecidæ*).

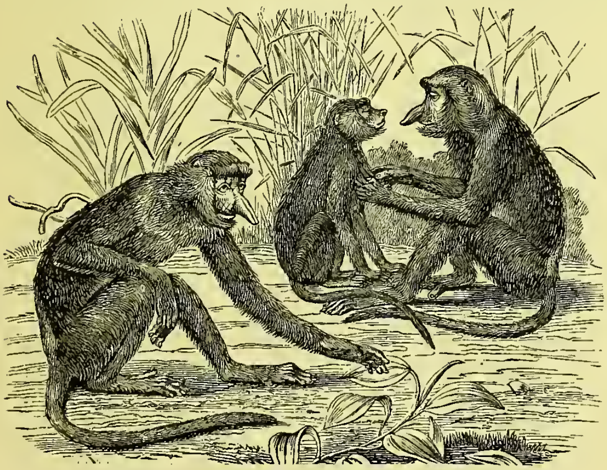
Two genera belong to this family—Semnopithecus and Colobus. In the former the fore-feet are pentadactylous, the thumb short; and all the known species are from Asia. In the latter the thumb is either wanting or a tubercle takes its place. In both there are buccal folds, the rudiments of pouches, and the face is little produced. The last molar tooth of the lower jaw has for the most part got a fifth accessory tubercle behind, and there is a sacculated condition of the stomach. The tail is long, often far surpassing in length the body. Of the eighteen species of Semnopithecus known, all of them are met with in the East. Along the Himalaya range, they extend to beyond Simla, where one species (S. schistaceus) has been observed at an elevation of more than 10,000 feet playing among the trees laden with snow. They extend as far eastward as Java; and Père David found a species (S. roxellana) at Moupin, about lat. 32° N., where the winters are severe. Of the more well-known species we may mention—the Entellus (*Semnopithecus entellus*), which, according to Captain T. Hutton, is entirely restricted within narrow limits to the hot,



SEMNOPITHECUS JOHNII.

tropical plains of the South-western Gangetic provinces, where, from the degree of protection which its imputed odour of sanctity is so well calculated to cast around it, as well as from the numbers in which it frequently occurs, it becomes a perfect nuisance. The true Entellus does not occur in Ceylon, and it would seem that the long-venerated name of Hanumân is applied, not only to S. entellus, but to several other species. This name is generally written by English naturalists as Hoonuman, but it should be pronounced as spelt above; the literal meaning is "Long-jaw." Hanumân was one of the monkeys of the monkey kingdom, the king of which—Báli—was killed by Rama, who placed his (Bális) brother Sugriva on the throne. Colonel Sykes says that the Mahratta name in the Western Ghauts is Makur. The Entellus cannot bear even so slight a change of climate northward as to Muttra. When being brought to Europe it is seldom able to round the Cape of Good Hope in perfect health, and it seems never long to survive its arrival. S. Johnii is another species of this genus, found in Malabar, which is not very unlike S. entellus.

The Long-nosed Monkey (*S. larvatus*) has a very prominent, conical nose. The nostrils are inferior. Wallace describes one as being about the size of a three years' old child, with a nose longer than that of the biggest-nosed man. The ears are small, and the face, together with the palms, are of a leaden colour, with a slight tinge of yellow. On the sides of the neck, which is short, and on the shoulders, the hair is long compared with that of the rest of the body. The top of the head and the upper portion of the back are of a rich chestnut brown; the sides of the face and a stripe over the shoulders are



THE LONG-NOSED MONKEY (*Sem. larvatus*).

yellow; the general colour of the body is of a sandy-red. The tail, like some other parts, is dark above and yellow beneath, and is somewhat tufted at the tip. A full beard, in the males, curls up under the chin, and reaches almost to the nose. The male is remarkable for his size and strength, and must be formidable, from the largeness of his canine teeth. The female is considerably smaller. According to Wurmb, "these monkeys associate in large troops; their cry, which is deep-toned, resembles the word *Kahau.*" This name has, therefore, been given to the long-nosed monkey. Wurmb also says, "They assemble morning and evening, at the rising and setting of the sun, along the borders of rivers, and are to be seen on the borders of lofty trees, where they offer an agreeable spectacle, darting with great rapidity from one tree to another, at the distance of from fifteen to twenty feet."

Of the other species we may mention S. Dussumierii, S. leucoprymnus (Ceylon); S. cucullatus (Malabar); S. obscurus (Malacca); S. albipes (Madras); S. maurus (Java); S. cristatus (Sumatra); S. femoralis (Singapore and Borneo); S. frontatus (Borneo); S. mitratus (Java); S. siamensis (Malay Islands); S. melalophus (Sumatra). Regarding this species, Dr. Müller remarks:—"In Sumatra we observed the Simpai, as well in the thick forests covering the mountains as in the plains along the sea-shore, but never at an elevation exceeding 3,000 feet above the level of the ocean. He is cautious and cunning, and at the same time extremely swift in his motions. He is rarely seen alone, but mostly in small companies of six, eight, or twelve individuals. His cry resembles that of the S. mitratus, but is more continuous, so that it nearly sounds as Hoe-ik-ik-ik-ik-ik-ik! His cheerful chattering is chiefly heard at the earliest dawn of the day or at twilight; and during our solitary excursions through the forests, the silence of midnight, when the moon shone bright, was occasionally enlivened by the cry of the Simpai sounding through the forest; and as he selects for his favourite resting-place the borders of brooks rushing through deep ravines, this contributes to increase the reverberating echo. During the day the Simpai rambles through the forests, frequenting the tops of those trees that produce his favourite food." S. rubicundus (Borneo); S. roxellana (Thibet); S. schistaceus (Nipal). Of this last species Captain T. Hutton writes:—"I fell in this morning with a whole lot of monkeys, Mussoorie Lungoors, and took a leisurely survey of them; they were dark-greyish, with pale hands and feet, white head, dark face, white throat and breast, and white tip to the tail. . . . . I have long thought that the Lungoor of our parts must be distinct from the Semnopithecus entellus of Bengal, on account of the different locality in which they are found. . . . . On the Simla side I observed them also, leaping and playing about, while the fir-trees among which they sported were loaded with snow-wreaths, at an elevation of 11,000 feet."

Of the next genus, Colobus, all the species are African. It is very closely allied to the former genus. The species from the west tropical region of Africa are: C. satanas (Fernando Po); C. polycomos (Fernando Po); C. angolensis (Angola); C. bicolor (West Coast of Africa); C. ferrugineus (Gambia); C. cristatus (West Africa); C. verus (West Africa); and the East Coast of Africa: C. Kirkii (Zanzibar); C. guereza (Abyssinia).

FAMILY III.—CHEEK-POUCHED MONKEYS (*Cynopithecidæ*).

This family comprehends all the monkeys with true cheek-pouches. In the baboons (Cynocephalus) the tail is very short. In some of the Macaques the tail is only indicated, in others it is long; while in some species of Cercopitheci it is as long and longer than the body. The species belonging to this family are by far the most widely distributed of all the Old World monkeys, one species being found as far north as Gibraltar, others in North China and Eastern Thibet. We cannot do more than give a short notice of the seven genera belonging to the family, which contain from sixty to seventy species. These naturally range themselves into a group of five genera, to be met with in Africa, and a group of two, met with in Asia and the Malay Islands as well.

The Talapoin (*Myopithecus talapoin*) has a globular-shaped head, with straight whiskers; the body and limbs are slender, the hands long, fingers united at the base, thumb large. The eyes and ears are prominent, so is the nose, with a thick septum and lateral nostrils. The fur is close, of an olive-green, whitish beneath. The face is black, upper lip yellow, with a few black hairs, orbits orange-coloured, eyebrows whitish, whiskers of a pale golden hue. It is met with on the west of Africa, and differs from the species of the next genus, in having only three tubercles on its lower last molar tooth. It bears some resemblance in its features and manners to some of the New World monkeys.

Cercopithecus.—This genus contains all the more graceful and prettily-coloured of the African monkeys. They range from the River Gambia to the Congo, and from Abyssinia to the Zambesi. The cercopithec monkeys are pre-eminently a sylvan race: they never abandon the forests, where they live in society, under the guidance of the old males. They seem to be much attached to particular localities. Each tribe or family has its own particular district, into which individuals of other tribes or species are never allowed to intrude, the whole community uniting promptly to repel any aggression, either on their territory or their individual right. So strongly is this propensity implanted within them that they carry it into our menageries. These animals generally take up their quarters in the vicinity of a running stream, and seldom approach the habitations of men, or invade the cultivated grounds of the gardener and husbandman. No doubt it is their spirit of union and mutual defence which prompts them to collect round travellers, when by their chattering, grimaces, and other means in their power, they endeavour to prevent an intrusion into the spot which they regard as their own.

Some of the species with an oval head and rather produced face, the fur greenish or reddish, have been separated as a sub-genus by Dr. Gray, under the name Chlorocebus.

Of the species we would enumerate—the Diana monkey (*C. diana*). This name was given to this animal by Linnæus, from the fancied resemblance of the crescent-shaped bar which ornaments its brow to the ancient poetical representation of Diana, the goddess of light, or to the moon. Its colour is peculiarly varied and graceful. The head, neck, sides, and middle of the body beneath, are of a deep ash-colour, which becomes gradually darker on the outside of the limbs, and is finally converted into a deep black on the hands. The tail also exhibits the same tendency to assume a gradually darker hue, and terminates in a point, which is perfectly black. Perhaps the general colour may be described as consisting of a mixture of black and white, in which the former greatly predominates, giving to the whole surface a slightly grizzled appearance. The hairs are for the most part tipped with white. The face is triangular, and, like the ears, intensely black. A straight line of long white hairs, surmounting a less obvious one of black, runs across the forehead above the eyes, extending nearly to the ears. The sides of the face are ornamented with broad tufts of white hairs, which are somewhat bushy, and terminate on the chin in a thin flat beard of two or three inches in length. The white hairs are continued down the front of the chest, and on the inside and anterior part of the fore legs, forming a large and well-defined patch, which does not in the least run into or mingle with the ash-colour by which it is bordered. A similar mark, but of less extent, and of a yellowish-orange, occupies the lower part of the abdomen, and extends down the inner and posterior sides of the hind legs, and the outer sides of the latter are marked by a narrow line of greyish hairs, extending from the crupper to the knee. On the middle of the back a band of dark reddish-brown, equally

SEMNOPITHECUS DUSSUMIERII.

well defined with the other markings, commences between the shoulders and extends to the root of the tail, becoming broader as it retires. The length of the animal, from the extremity of the muzzle to the crupper, is about eighteen inches, and that of the tail about two feet. It is furnished with small but distinct callosities, and with cheek-pouches of no very great extent.

Linnæus describes a Diana monkey as fond of every kind of vegetable diet, but particularly of fruits, raisins, nuts, and almonds; it also ate willingly eggs and bread, but it did not relish animal food; it drank often, and before taking anything would always smell it. It delighted in hot weather, and when the cold season commenced gave vent to its uneasiness in shrill complaints. It overturned everything that was put before it, even the vessel that was set down for its food. When a stranger was introduced it showed its teeth and bowed its head repeatedly. If enraged by any one, it endeavoured to bite its aggressor.

The Mona (*C. mona*) is even more graceful in its form and beautiful in its markings than the Diana. The top of its head is of a greenish-yellow mingled with a slight tinge of black, and the neck, back, and sides are of a deep chestnut brown, extending as far as the shoulders and haunches, when it changes into a dusky slate colour, which is continued on the limbs and the tail. The latter part is considerably longer than the body, and has on each side of its base a very remarkable white spot. The under surface of the body and the inside of the limbs are of a pure and delicate white, separated from the neighbouring colours by an abrupt line. The naked upper part of the face, comprehending the orbits of the eyes, together with the cheeks, is of a bluish purple; the lips, and as much of the chin as is without hair, are flesh-coloured. On the sides of the face large bushy whiskers of a light straw-colour, mixed with a few blackish rings, advance and cover a considerable portion of the cheeks. Above the eyebrows is a transverse black band, extending on each side as far as the ears, and surmounted by a narrow crescent-shaped stripe of grey, which is sometimes scarcely visible. The ears and the hands are of a livid flesh-colour.

THE WHITE-NOSED MONKEY
(*Cercopithecus petaurista*).

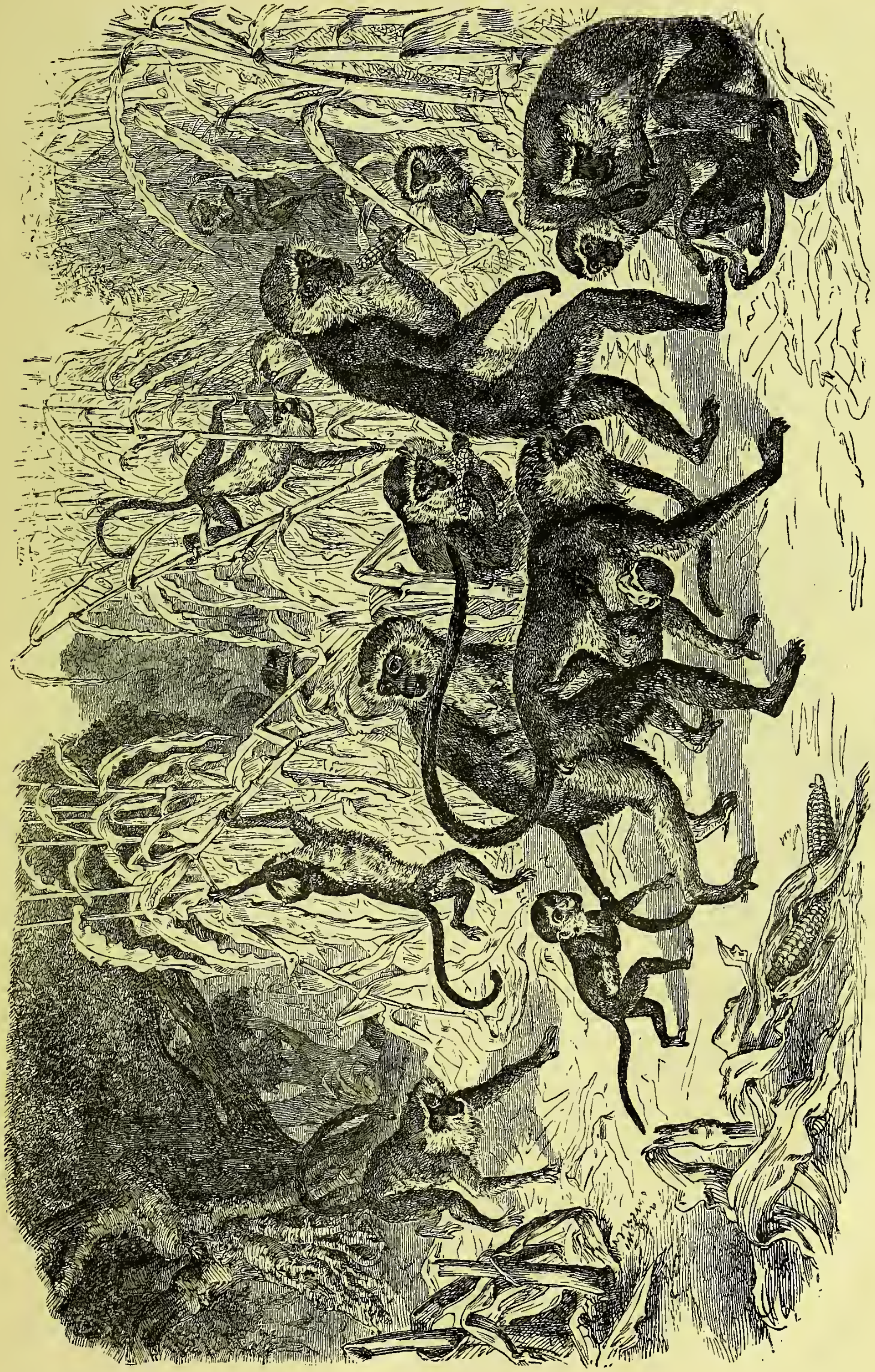
The little White-nosed Monkey (*C. petaurista*) is a native of Guinea.

The Grivet (*C. griseo-viridis*), or Monkey of Saba, is a native of Nubia, on the borders of the White Nile, and also of Abyssinia. These animals have been brought alive to Europe, and have frequently been exhibited in menageries. The ancient Egyptians knew the Grivet. This is probably the animal the ancient Greeks spoke of under the name of *Kepos;* and it may be that to which Pliny applied the name of *Callithrix.*

All the outer parts of the body are of a dirty green colour, caused by an abundance of hair in circles of blackish-grey and livid yellow. The internal facings of the limbs and body, the anterior covering of the shoulders, neck, and internal facings of the tail, are white. The ears, palms of the four hands, and face, are violet-black. The circle round the eyes is of a livid flesh-colour, and some long, stiff, and black hairs grow on a crest between the eyes. A male, of which F. Cuvier gives a likeness, was malicious and dangerous in its familiarity. A female of the same species, on the contrary, always preserved its docility. This female had been trained with great gentleness, and never received anything but caresses from its master. Accordingly, it acquired no small degree of confidence and affection.

Many Egyptian monuments and paintings in the Pyramids and on the sarcophagi have representations of monkeys which appear to be Grivets, the tail being raised over the back of the animal. The shape of the head leaves little doubt as to the animal thus portrayed, and the relation of the Egyptians to the people of the Upper Nile appears to set the matter at rest.

The Green Monkey (*C. callitrichus*) is a native of the Cape de Verds; it is a very common importation to these countries.



DIANA MONKEYS.

The Patas (*C. ruber*) is found in Senegal. A well-marked Eastern representative of the Patas is met with in the Nisnas (*C. pyrrhonotus*, Ehr.), from southern Nubia.

The Malbrouck Monkey (*C. cynosurus*) is described by F. Cuvier as of truly arboreal habits, walking with difficulty on the ground, and exhibiting the greatest activity when sporting on the bars of its cage. The one he observed would sustain itself by successive darts from one side of its cage to another, performed by the force of its feet alone, and would keep up this severe motion for a considerable time. When young it was docile and mild-tempered, but as it grew old it became savage and sullen. The chief characteristic of its disposition was extreme caution, or, as it were, an arrangement beforehand, or previous plan of action; thus, in its attacks, it watched the opportunity, when the person or animal was off his guard and otherwise employed, and it always made the attack from behind.

The Vervet Monkey (*C. lalandii*), from South Africa, is nearly as often seen in this country as the Green Monkey.

The following list of species, to which we will not more particularly refer, is taken from Dr. Gray's catalogue:—C. martinii, nictitans, erythrotis, pogonias, Erxlebenii, Campbellii (Fernando Po); C. cephus, melanogenys, ludio, erythrogaster (West Africa); C. leucocampyx (White Nile); (C. Pluto Angola); C. samango and pygerythrus (South Africa); and C. rufoviridis (Mozambique).

WHITE-COLLARED MANGABEY (*Cercocebus collaris*).

Cercocebus.—The species of this genus called Mangabeys are very closely allied to those of the genus Macacus; indeed, they may be regarded as representing on the west of Africa the Macaques of the north and east. The face is more or less produced. The last lower molar has five tubercles; the whiskers are small, the eyebrows prominent, with white eyelids.

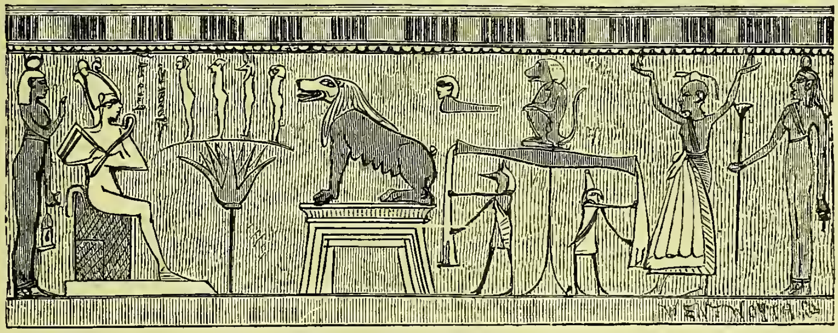
In one species, C. albigena, the hair on the forehead forms a compressed crest. This species is now and then to be seen in the Zoological Gardens, but the best known species is the Sooty Mangabey (*C. fuliginosus*). In this animal the whole of the upper surface of the body, the tail, and the outsides of the limbs, are of one uniformly deep greyish-black, or more properly soot-colour, becoming black on the lower part of the legs and of the hands. On the under part of the moustaches, which are bushy, spreading, and directed backwards, the fore part of the chest, the under surface of the body, and the inside of the limbs, the general colour is of a light grey, with only a slight mixture of a dusky hue. The fingers are long and slender; the ears rather small and blackish; and the whole face livid, with a dark tinge round the eyes, and on the nose, lips, and chin. The tail is thick and cylindrical, scarcely tapering even towards the point, and generally turned backwards over the body, which it exceeds in length. A female of this species, exhibited in Wombwell's Menagerie, was very lively, never for a moment at rest, and particularly active when observed, as if she liked her gambols to be noticed. Some of her attitudes were very extraordinary. She was extremely gentle, and never resented any of the tricks played upon her by thoughtless visitors. She was remarkably clean, and very careful not to soil her person, was delighted to see strangers, and seemed flattered by their attentions. When feeding she seldom put her head to the food or dish, but lifted and conveyed it to her mouth. Her diet was chiefly bread and milk, and occasionally vegetables, a carrot being a very favourite luxury.

C. collaris is blackish-grey, with the cheeks, collar, throat, and chest white. A variety with the tail end white is often met with. The other species are C. œthiops and C. lunulatus.

The next genus, Gelada, contains a baboon-like species, G. Ruppelli. The head is oblong, the face produced and rounded, the neck has a mane, the tail is cylindrical, short, and tufted. In colour we find the face, hands, and callosities deep black, the head, whiskers, neck, and sides, sooty grey; the shoulders and back, black. It grows to a length of three feet and a quarter, and is met with in the mountains of Abyssinia, at heights of from 7,000 to 8,000 feet.

The Baboons belong to the genus Cynocephalus. They are found in all parts of Africa, and one species in Arabia. Some of them are of large size; they have an elongated, dog-like muzzle, with nostrils opening at its end; the hands and feet are short. the thumb is large. In some the tail ends in a tuft of long hair, and they possess a mane; in others the tail is hairy all round, and there is no mane.

The Arabian Baboon (*C. hamadryas*) has the tail ending in a large tuft of hair, and the necks and shoulders of the males are largely maned. It is of an ashy-grey colour, with long slate-coloured whiskers. The face and the ears are flesh-coloured, the hands are black, the callosities large and bright red. They live in large herds, numbering from eighty to a hundred, and are to be found in the mountains in Arabia, throughout Abyssinia, in Sennaar, Kordofan, and Darfur—even as high as 8,000 feet. Their voice is a deep, hollow roar. They were worshipped and embalmed by the Egyptians.



EGYPTIAN JUDGMENT-SCENE.

This baboon was particularly sacred to Thoth, and was worshipped as the type of the god of letters, which was one of the characters of Thoth, or as an emblem of the moon. It was even introduced in the sculptures as the god himself, with "Thoth, Lord of Letters," and other legends, inscribed over it; and in astronomical subjects, two baboons are generally represented standing in a boat before the sun in an attitude of prayer, as emblems of the moon. Their presence in a similar boat with a pig probably refers to them as types of the divinity in whose honour that animal was sacrificed, "the moon and Bacchus," according to Herodotus, "being the sole deities to whom it was lawful to immolate swine, and that only at the full moon." But their presence was not alone emblematic of Thoth or the moon. On two sides of the pedestals of the obelisks of Luxor four baboons stand in the same attitude, as if in adoration of the deity to whom these monuments were dedicated; a balustrade over the centre doorway of the Temple of Amun at Medeenet Haboo is ornamented with figures of these animals; and a row of them forms the cornice of the exterior of the great temple dedicated to Re, at Aboosimbel. Sometimes a baboon placed upon a throne, as a god, holds a small ibis in its hand; and in the judgment-scenes of the dead it frequently occurs, seated with scales before him, as the emblem of Thoth, who was considered to have an important office on that occasion, judging the spirits of the deceased, and registering their actions.*

The place where the baboon was particularly sacred was Hermopolis, the city of Thoth. Thebes and other towns also treated it with the respect they deemed due to the representative of the Egyptian Hermes; and in the necropolis of the capital of Upper Egypt, a particular spot was set apart as the cemetery of the sacred baboons.

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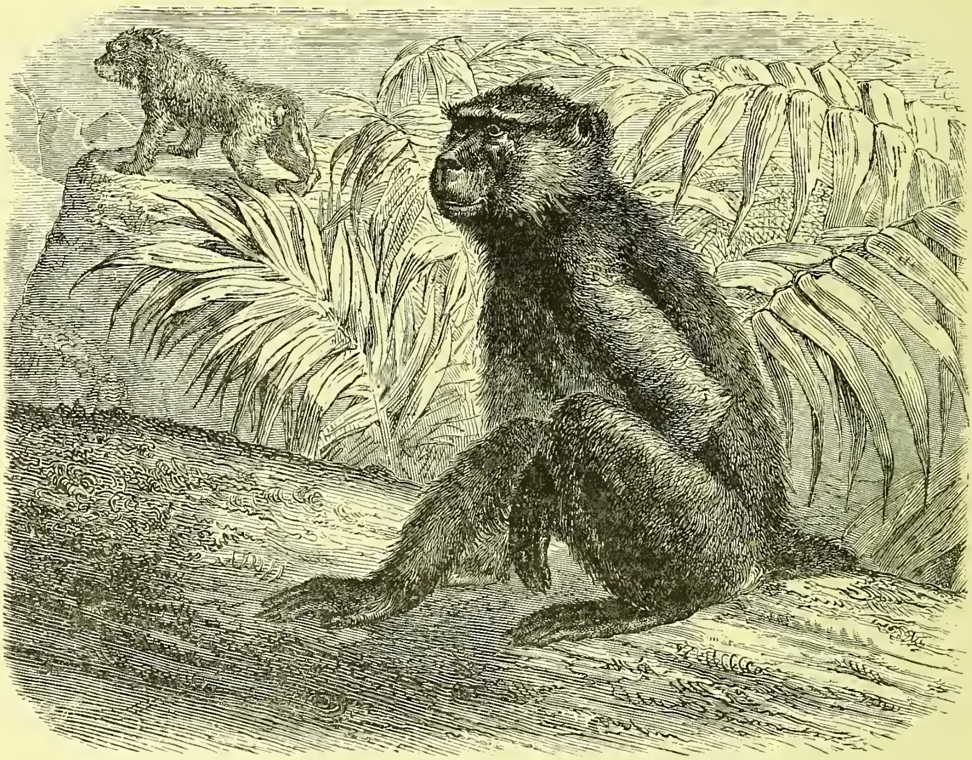
* Sir J. G. Wilkinson.

Mummies of this animal are generally found in a sitting posture, which is that usually given to the animal in the sculptures, when representing the god Thoth. A baboon's head forms one of the covers of the four sepulchral vases deposited in the tombs of the dead. It was the type of the god Hapi, one of the four genii of Amenti, that was always represented with the head of a baboon.

The baboon was at one time tamed in Egypt for various purposes; and it is still taught some useful accomplishments. Among these is that of officiating as torch-bearer at a supper party; when, seated in a row on a raised bench, a troop of these animals hold the lights until the departure of the guests, and patiently wait their own repast as a reward for their services. "Sometimes," says Wilkinson, "a refractory subject fails in his accustomed duty, and the harmony of the party is for a moment disturbed, particularly if an unruly monkey throws his lighted torch into the midst of the unsuspecting guests; but the stick and privation of food is the punishment of the offender; and it is by these persuasive arguments alone that they are prevailed upon to perform their duty in so delicate an office."



THE CHACMA (*Cynocephalus porcarius*).

Many of these creatures are brought from Ethiopia to Cairo at the present day, to amuse the crowds in the streets, by exhibiting the antics they are taught, to the sound of drums and other noisy instruments; but the constant application of the stick shows the little respect now paid in Egypt to the once revered emblem of Hermes.

The common name for this class of animals is supposed to be derived from the barbarous Latin word *papio*, applied to them by the writers of the fifteenth and sixteenth centuries, and which is itself a diminutive of the Italian word *babbo*, answering to our word *papa*. The name given them by Cuvier is compounded of two Greek terms, meaning *dog* and *head,* which is highly appropriate, from the marked resemblance of the head and face to those of a dog, observable in our engraving. Accordingly, the Greeks and Romans called them dog-headed monkeys.

In their native mountains the ordinary food of the baboons are berries and bulbous roots, but in the vicinity of human habitations they make incursions into the cultivated fields and gardens, and destroy a still greater quantity of grain and fruits than they carry away. Travellers state that, taught by experience of the risks to which they expose themselves during their expeditions, these baboons place sentinels on the surrounding heights and trees, to give timely warning of approaching danger. Pearce, in his "Adventures in Abyssinia," says: "I have myself seen an assembly of baboons drive the keepers from the fields of grain, in spite of their strings and stones, till several people went from the village to their assistance, and even then they only retired slowly, seeing that the men had no guns."

THE YELLOW BABOON (*C. babouin*).

The Chacma (*C. porcarius*) has its singular name from a Hottentot word, T'Chackamma. When full grown, it is equal in size, and superior in strength, to a common English mastiff. It inhabits the mountains of the Cape of Good Hope, and associates in families more or less numerous. Table Mountain, the north front of which is so prominent an object in the view from the capital of Cape Town, and which extends for the length of two miles from east to west, is still one of their dwelling-places, though they do not inhabit it in such great numbers as formerly. They pay occasional visits to the gardens beneath, and with such skill and caution do they direct their movements, that the dogs are often unable to prevent their ravages. They are accustomed to go on these marauding expeditions in large numbers, to support each other reciprocally, and to carry off their plunder in greater security.

Their common food consists of bulbous roots of different kinds, particularly the babiana, so called by the Dutch colonists, because their subterranean stems are so eagerly eaten by these baboons. They dig them up with their fingers, and peel them with their teeth; and hence heaps of the peelings are observable near the large stones on which they delight to sit and look around them. In ascending the kloofs or passes of the mountains, which are frequently steep, narrow, and dangerous, travellers often disturb troops of these animals, which have been sunning themselves on the heights. If they are not attacked they scamper up the mountain-sides screaming and yelling, but if fired at and wounded, they no sooner get beyond the range of the gun than they roll and throw down stones, and by every means in their power resent the injury.

It was a Chacma of which Le Vaillant has given so amusing a description, in the account of his first journey into the interior of Africa. This animal, called Kees, the traveller says, "often rendered me essential services; his presence has frequently interrupted or banished from my memory the most bitter and harassing reflections; his simple and touching affection even seemed, on some occasions, to anticipate my wishes, and his playful tricks were a perfect antidote to *ennui.*" A few of the statements of this vivacious writer, in reference to this remarkable creature, we will here condense.

When the traveller met with any fruits unknown to himself and his Hottentots, Kees was appointed "taster-general;" if he ate they did so with confidence; if he rejected them they did so likewise. He became, too, a trusty guardian; night or day, it mattered not, the most distant approach of danger roused him to instant watchfulness, and his cries and gestures betokened something unusual, long before the dogs of the party appeared aware of its occurrence. They relied so entirely on the vigilance of Kees, that they neglected their own duty, and instead of watching the encampment went to sleep, as if in full confidence; but no sooner had he given an alarm than the whole pack were up and on the alert, flying to defend the quarter from which his motions induced them to expect the threatened danger.

The Drill (*C. leucophœus*) and the Mandrill (*C. mormon*) are both from the West of Africa. In both the face is grooved. The Drill is a native of the coast of Guinea, and is distinguished by a short, erect, stumpy tail, scarcely two inches in length, and covered with short, bristly hair. The cheeks are protuberant; the colours of the body are mixed with green on the upper parts, and are of a light or silvery hue beneath. The whiskers are thin, and directed backwards; there is a small, orange-coloured beard on the chin, and the tail is terminated by a small brush. The face and ears are naked, and of a glossy black colour, like polished ebony.

The Mandrill usually measures five feet in height when full grown. The head is very large in proportion to the size of the body. The face, which is naked, presents a very remarkable appearance, the cheeks being of a clear violet-blue colour, with various oblique furrows, which are produced by a singular development of the bone, forming a socket for the roots of the immense canine teeth, and furrowed also obliquely. A bright vermilion line begins a little above the eyes, runs down the nose, and spreads over the lip. The eyes are small, but acute and sparkling, the iris being of a fine hazel-colour. The hair on the sides of the head is long, mostly growing upwards, and terminating in an acute pointed form on the crown. The beard is long, erect, and of a yellowish hue. The whole body is covered with stiff bristle-like hairs, each of which has rings of black and yellow. The hands are small, taper, and well made; and the chest is extremely muscular.

The food of the Mandrill, like that of the monkey tribe generally, consists of fruit, grain, and roots. The creature shows, however, a fondness for animal diet. One of these animals, on being offered a live bird, killed it with a bite, and devoured it, after stripping off its feathers. A rabbit was then given to him, which he also killed with a bite across the back, and he was about to eat it, when it was removed.

Of the other baboons we need only enumerate C. anubis, C. babouin (see engraving, p. 36), C. sphinx, all from West Africa, and often to be seen in the Zoological Gardens.

The genus Macacus contains some of the best-known forms of Old World monkeys. The face is produced and rounded, the eyes are placed so as to be guarded by the projecting edge of the frontal bone; the tail varies much in length, and is sometimes almost wanting; the tip is never tufted. The last molar in the lower jaw has got five tubercles, the two other true molars are four-tubercled.

We commence our notice of the species with the Bonnet Monkey (*M. radiatus*). The forehead of this animal is suddenly depressed behind the eyebrows, of which the ridge is very bold. The skin of the forehead is transversely wrinkled, and covered with short hairs, which are continued round the temples and occupy the space before the ears. A circular cap of rather long hair, radiating from the centre, is placed flat on the crown. The muzzle is prominent, and the physiognomy sometimes malicious; the form is robust, the tail long. The general colour is greenish, or olive-grey, the hairs being in rings of dusky black and pale yellow; the under surface is ashy-white; the ears are large and flesh-coloured, with straggling long grey hairs. The limbs are of a paler tint than the back. The Bonnet Monkey appears to be widely distributed throughout India. It is found in Malabar; it inhabits the Western Ghauts; it is abundant in Madras; and even in the southern regions of Nepaul. In the Mahratta country—where portions of the primeval forest, left untouched by the axe or knife, form an impervious shade favourable to the growth of tropical plants—these animals delight to dwell. Here it may be seen in troops, tenanting the wildest jungles; but they do not confine themselves to these woodland recesses; they are quite at home in the most populous towns, where they carry off fruit and grain with the greatest coolness and address.

A writer on the monkeys of India says :—"Although a good deal shyer of me than they were of the natives, I found no difficulty in getting within a few yards of them; and when I lay still among the brushwood, they gambolled round me with as much freedom as if I had been one of themselves. This happy understanding, however, did not last long, and we soon began to wage war on each other. The *casus belli* was a field of sugar-cane I had planted on the newly-cleared jungle."

No monkey affords greater amusement in menageries than the Bonnet Monkey, performing its movements with imperturbable gravity. It is indeed indescribably droll to see these animals hugging and nursing one another.

Gentle as the Bonnet Monkey is when young, as it grows older it becomes extremely irascible, and ever ready to take offence on the slightest occasion. Of this the following anecdote is an instance :—An animal of this kind, exhibited in a travelling caravan, had a cat of considerable size to keep it company in its confinement. One day puss felt, as she had often done before, somewhat drowsy, and, retiring to the quietest part of the cage, tried to enjoy a comfortable nap. The monkey, however, was neither inclined to sleep, nor to let any creature that was within his range do so; and, having selected a stiff straw, he amused himself by poking it up the cat's nose. Puss bore the annoyance patiently for a time, but as it became intolerable, she gave her tormentor a sharp scratch on the face. The monkey, who could not brook so painful an indignity, seizing the unfortunate culprit by the tail, and flying with the greatest speed to the top of the cage, held her firmly suspended, while he inflicted on her such a series of cuffs and pinches, as no doubt warned her not to repeat the offence.

The anger of the Bonnet Monkey is particularly apparent when it is tantalised by being offered any species of food which is then withdrawn; and it is ludicrous on such occasions to witness the serious displeasure portrayed in its countenance, while it pouts with its lips, looks fixedly in the face of its tormentor, mutters a low complaint, or suddenly darts forth its hand, intent on a scratch, by way of retaliation. Even when not thus provoked, it is always precipitate in its actions, and snatches with hasty rudeness the food which is offered to it, never pausing to eat it at the moment, but stowing it away in its capacious cheek-pouches, and begging, with pouting lips and outstretched arms, for a further supply. So long as visitors to menageries continue to give, it never refuses to receive; and it is only when all hope of more is gone that it retires to a corner, and, opening its pouches with the aid of the bent knuckles pressed on the outside of the cheeks, devours their contents piecemeal, and is ready to fill them again from the first hand that offers a supply.

The Rhesus Monkey (*M. erythrœus*) is also a well-known species. The general colour of this animal's fur is olive-green, with brown on the back; the crupper and thighs are externally orange-red, the callosities and naked skin around intensely red; the skin of the throat and abdomen is loose, and usually hangs in folds; the tail is short.

M. F. Cuvier had an opportunity, not of frequent occurrence during the captivity of monkeys, of observing a young Rhesus from its birth. It clung to the body of the mother, holding her firmly by the fur with its hands and feet, and continuing to suck for fifteen days, sleeping when the mother was quiet, but never quitting its hold even when asleep. From the first moment of its life it appeared to distinguish objects, and to regard them attentively; it followed with its eyes the different movements that were made around it, and seemed born with the power of measuring distances by the eye, unaided by the sense of touch.

The care and attention of the mother in everything relating to the preservation of her offspring were as provident as can well be imagined. She never heard a sound, or observed a movement, without having her attention and solicitude aroused. Its weight did not seem to impede her movements, which she managed so adroitly that, various and complicated as they were, it was perfectly safe. At the end of about fifteen days the little monkey began to detach itself from its mother, and, from its very first attempt, displayed a surprising address and precision. It fixed itself to the vertical bars of its cage, and climbed and descended them at will; but the mother's eye always followed it, and her hand was ready to assist or support it; and after a few seconds of liberty it returned to its original position.

Before long, the mother might be observed, at times, attempting to get rid of the trouble of nursing, though she never lost her solicitude for the young one's safety; for no sooner did danger threaten than it was again pressed in her arms.

In proportion as the powers of this Rhesus were developed its leaps and gambols became perfectly surprising. M. Cuvier says: "I took a pleasure in examining it during these moments of gaiety, and I may say that I never knew it to make a false movement or a false calculation, or fail to arrive with the utmost precision at the very spot it intended. From this observation I had an evident proof that a particular instinct guided it in judging of distances and determining the degree of force necessary to accomplish a particular action. It is certain that, with the intelligence of man, this animal would have required numerous trials and multiplied attempts to accomplish what it here did perfectly well from the first, yet it was now scarcely a month old."

THE MAGOT (*Macacus inuus*).

It was only at the end of about six weeks that a more substantial nutriment than milk became necessary for the support of this young animal. And now the solicitude and love of the mother began to diminish; she would not permit it to touch the least morsel of food, deprived it of the fruit and other things given it, drove it away whenever it approached the vessel holding their common provisions, and hastened to fill her cheek-pouches and hands, that nothing might escape her. It was, however, only at meal-times she was thus ravenous and unnatural; at other times she attended to all the wants and actions of her offspring with care and affection.

The Wanderoo (*M. silenus*) is a native of Malabar and Ceylon. Some of them are described by Knox as being "as large as our English spaniel dogs. The general colour of this species is black; the tail is of moderate length and tufted at the tip; the face is encircled by a mane of long hairs of a whitish or light ash-colour, and sometimes pure white; the callosities are flesh-coloured, and the face is black. They do but little mischief, keeping in the woods, eating only the leaves and buds of trees; but when they are caught, they will eat anything."

A Wanderoo was for some time in the possession of Mr. Cross, at Exeter 'Change, and had for a companion in the same cage a young Mandrill, which, not having attained to the moroseness of the adult, was much disposed to sportiveness and play. The Wanderoo, though not so often "i' the vein" for wanton gambols, would, however, not unfrequently join its companion, and did not exhibit that degree of malevolence attributed by some naturalists to the species. Its attention seemed generally occupied by anything that was passing out of the limits of its prison-house. Another specimen in Wombwell's collection of animals was so far gentle and sociable as not to be confined within a cage, but was merely fastened by a light chain of some length, in which situation it might have found opportunities, had it been so disposed, of gratifying a malicious and savage inclination. It is frequently to be seen in the Zoological Gardens, and it is said to be now naturalised in China.

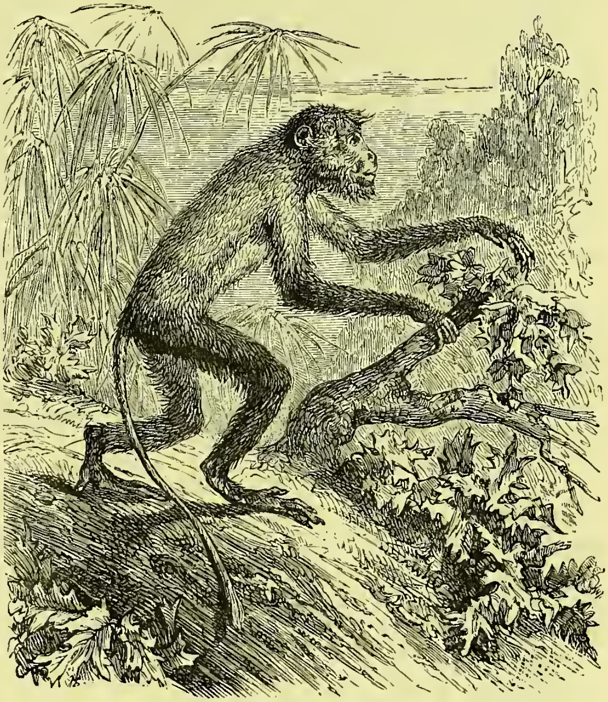
The Barbary Ape or Magot (*M. inuus*) is the only species of quadrumana found in Europe. The tail is very short, reduced to a small tubercle. It is to be met with at Gibraltar, Barbary, Morocco, and North Africa in general.

The most celebrated abode of this species is the Rock of Gibraltar, in Andalusia, the most southern province of Spain, connected with the continent by an isthmus of low sand, and almost surrounded by the waters of the Mediterranean. Numbers of apes have been observed on its summit, breeding in inaccessible places, and appearing in large droves, with their young on their backs, on the western face of the rock. Frederic Cuvier says that they walk most commonly on all-fours, while at the same time they are very active climbers. He confirms the opinion previously held that they are gregarious, filling the forests with their vast troops, and openly attacking the enemies they think they can overcome, while they drive to a distance, by their numbers and screaming, any intruder of whose powers they are doubtful.

The Spaniards, a few weeks before the memorable siege, are said to have attempted the surprise of one of the British outposts; and they would have inevitably succeeded if they had not had to pass a party of apes, whose assemblage was quite as extraordinary as the project of the Spaniards. These, on being broken in upon by the invaders, set up a loud cry, and alarmed the outpost which was menaced. Surely these animals deserved as well of our garrison as the geese did of that of the Capitol!

When Lord Howe went out to its relief he took with him, amongst other reinforcements, the 25th Regiment of infantry. Shortly after the conclusion of peace, a party of officers belonging to this corps were amusing themselves with whiting-fishing at the back of the rock, but were disturbed and obliged to shift their ground on account of being pelted from above, they did not know by whom. At last, however, they came to a place where they were left in peace, and where they caught plenty of fish. At this time the drums beat to arms, on some unexpected occasion, and the officers rowed their boat ashore, and left it high and dry on the beach, hurrying where their duty called them.

On their return, their surprise was excessive to find their boat beached, not half so high as they had left it, and at some little distance from its former position. Their amazement was increased, on examining their tackle, to find some hooks baited which had been left bare, and to see the disposition of many things altered. The cause was afterwards explained. An officer of Hanoverian grenadiers, who was amusing himself with a solitary walk, happened to be a close observer of animal and vegetable nature. He, hearing the chattering of monkeys, stole upon a party of young ones, who were pelting the fishing party from behind some rocks. While they were so employed two or three old ones arrived, who drove the youngsters away, and then remained secretly observing the proceedings of the whiting-fishers.



THE MACAQUE (*Macacus cynomolgus*).

The fishing party having beached their boat and retired, the apes apparently deemed the time was come for turning their observations to account. Accordingly they launched the boat, put to sea, baited their hooks, and proceeded to work. Their sport was small, as might be anticipated, from the impatient nature of the animals; but what few fish they caught were hauled up with the greatest exultation. When they were tired they landed, placed the boat, as nearly as they could, in her old position, and went up the rock with their game.

General Elliott never suffered the apes to be molested or taken; but one had been made prisoner previously to the time of his being made Governor of Gibraltar, and was kept chained up in his yard. Another monkey, who had apparently fallen from a rock, had been picked up by one of the general's aides-de-camp, and conducted to the same place. Nothing could be more striking than the meeting of the pair. It was evidently the recognition of two old friends or relations. After contemplating each other for a few seconds they rushed into one another's arms, then pushed each other a little back, as if to make sure of their recognition, and after a second mutual examination again clasped each other to their breasts.

Of the other species we must mention the Macaque (*M. cynomolgus*), so common in most menageries. It is, perhaps, the most widely distributed of all the monkeys inhabiting the Indian Archipelago. It is one of the few monkeys known to breed in confinement. In early life it is intelligent, good-natured, and docile, being easily trained to the performance of amusing tricks. It is frequently found on board ships, where it is commonly called Jakko. It is a great favourite with the natives of Java, by whom it is domesticated and placed in stables as a companion to their horses. In old age its character changes, and it becomes morose, sullen, and mischievous. The Pig-tailed Monkey (*M. nemestrinus*) is found in Java, Sumatra, Borneo, and Sir T. Raffles says that the Javanese teach it to climb the cocoa-nut palm-trees for the purpose of procuring the fruit, and that it selects the ripe from the unripe fruit with admirable ease, plucking no more than its master desires. A mere enumeration must suffice for M. pileatus (Ceylon), M. sancti-Johannis (Hong Kong), M. leoninus (Burmah), M. lasiotus (interior of China), M. cyclopis (Formosa), M. pelops (Himalayas), M. assamensis (Bhootan), M. speciosus (Japan), M. maurus (Borneo), M. ocreatus (Celebes), M. melanotus (Madras), M. Thibetanus (Thibet).

The last genus of this family is that of Cynopithecus. It contains but a single species, the Black Ape (*C. niger*). This is a black baboon-like ape, inhabiting Celebes, Batchian, and the Philippine Islands, though, according to Mr. Wallace, it may have been introduced by man into the two latter localities. It is the farthest dweller to the east of all the monkeys. Its face is elongated, rounded, black, and bald. The nose is broad, flattened behind nearly to the eyes, sides erect. It has a flattened crest. The tail is reduced to a mere tuberel.

FAMILY IV.—THE CEBIDÆ.

It will be recollected that the species of the first three families of monkeys were all to be met with in the Old World. We now come to a large family containing species to be only met with on the continent of America. They are absent from the West Indies. They are, on the whole, in comparison with the monkeys of the Old World, smaller. They have an additional molar tooth in each jaw. In the Old World monkeys the nostrils are generally separated by a narrow septum, and open obliquely under the nose (whence called *Catarhini*). In the New World monkeys the septum severing the nostrils is broad, and the nostrils open laterally (hence called *Platyrhini*). These monkeys never have cheek-pouches. The thumb on the anterior limbs is only very slightly different from the other fingers, and is never completely opposable, so that they were named by Mr. Ogilby, Pedimana. This great family contains more than eighty species, which are divided into ten genera. These can be very naturally grouped into four sub-families.

SUB-FAMILY 1.—MONKEYS WITH PREHENSILE TAILS (*Cebidæ*).

The monkeys of this sub-family have long prehensile tails—this peculiarity is not found in any of the Old World forms. When the tail is extended, it naturally, and without any voluntary effort, forms a hook-like curve at its extremity, with which it grasps anything tightly within its folds. In connection with this peculiarity we find that the last tail vertebræ are dilated. In two of the genera—Ateles and Lagothrix—the tails are very powerful organs of prehension, the tips being bare beneath. In the typical genus, Cebus, the tail is complctely covered with hair, and though not so perfect a grasping organ as in the other genera, it is prehensile.

Cebus.—This genus contains the largest number of American monkeys. The head is large and rounded, the limbs are proportionate. They are gregarious and lively, feeding on fruits and insects. They have a range from Costa Rica to Paraguay. They are generally called Capuchins, or Sapágoris, and are very frequently to be seen in menageries. Dr. Gray enumerates sixteen species.

The Brown Capuchin (*C. fatuellus*) has a rather harsh reddish-brown thick fur, darker on the middle of the back, tail, and legs; the forearms, crown-spot, and whiskers black or blackish; front of the shoulders paler or slightly yellowish; the crown-spot is broad, often produced on the sides into more or less thick elongated longitudinal crests. This is a rather variable species, which comes from Brazil. Geoffroy and Desmarest give French Guiana as its native country. It is one of the largest species in the family, and is the one oftenest seen in confinement.

The Weeper Capuchin (*C. capucinus*), from Brazil, is often, too, to be seen in our menageries. It commends itself by its good temper, playful disposition, and hardy constitution.

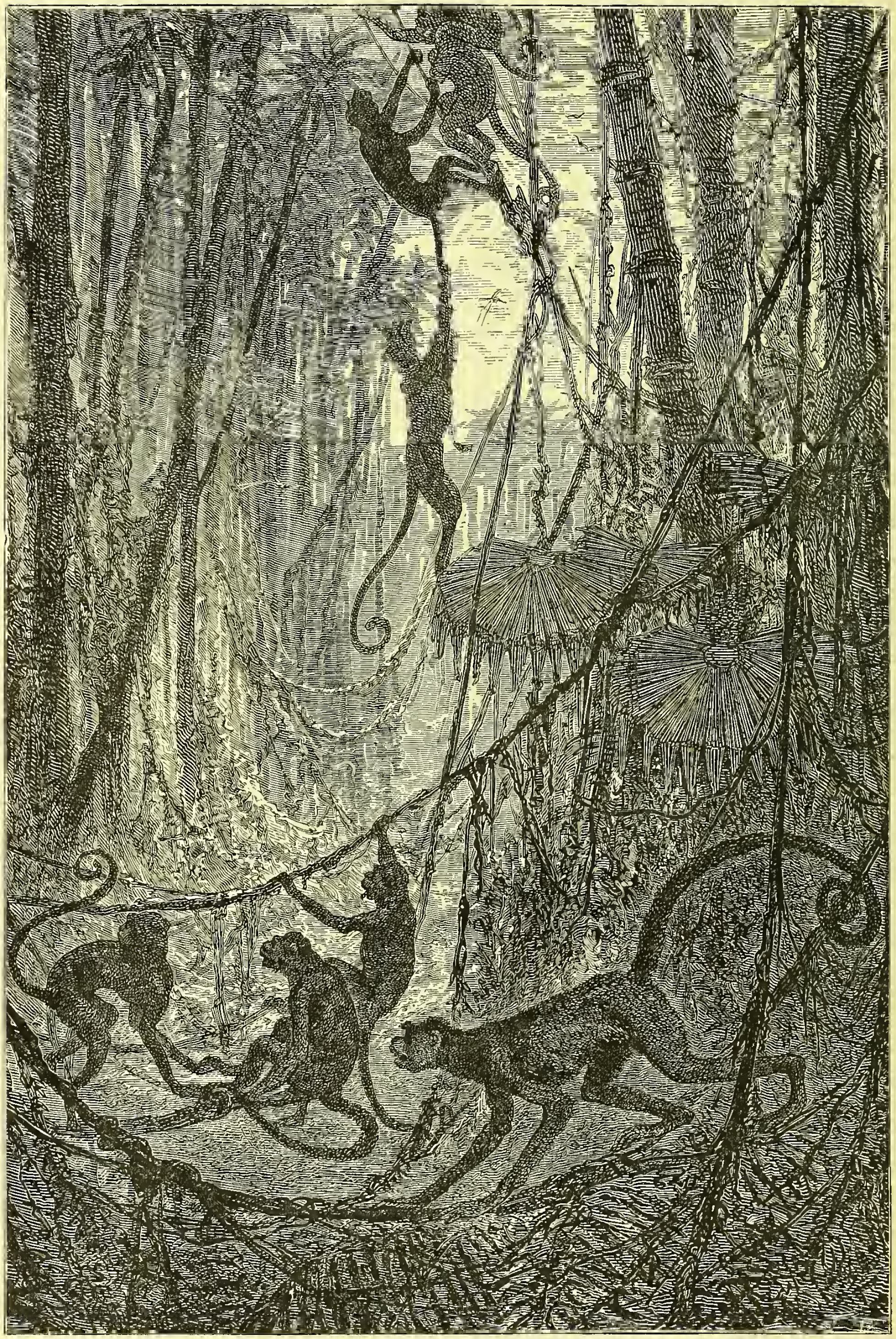
The White-throated Capuchin (*C. hypoleucus*) comes from Central America and Caraccas. While the fur is a dark reddish-brown, the forehead and front of crown, the neck and sides of head, are white, also the shoulders and chest; the face is pale flesh-coloured.

The following is a list of the other known species :—C. leucogenys (Brazil), C. pallidus (Bolivia), C. cirrifer, C. vellerosus (Brazil), C. xanthocephalus (Paraguay), C. albifrons (Brazil), C. leucocephalus (Columbia), C. flavescens, C. robustus, C. chrysopus, C. capillatus (Brazil), C. subcristatus (South America).

Lagothrix.—This genus contains a few species of monkeys confined to the forests of the Upper Amazon Valley, and along the slopes of the Andes to Venezuela and Bolivia. Their fur is soft, woolly, and black; the head is round and beardless; feet are very long; thumbs well developed; the tip of the tail is naked; they are gregarious; rather larger and less active than the Capuchins, and sometimes walk on their hind legs. The best known species is L. Humboldti, from the Upper Amazons, a beautiful figure of which will be found on Plate 31 of the "Proceedings of the Zoological Society of London" for 1863. Mr. Wallace had three of these rare monkeys with him on his way home from South America, but they perished when the ship he was in was burnt at sea. He had had them as companions for several months before leaving Brazil, and found them to be of a very gentle disposition. In the Upper Amazons they are the species most frequently seen tame, and they are great favourites, from their grave countenances—more resembling the human face than any other monkeys—their quiet manners, and the great affection and docility they exhibit.

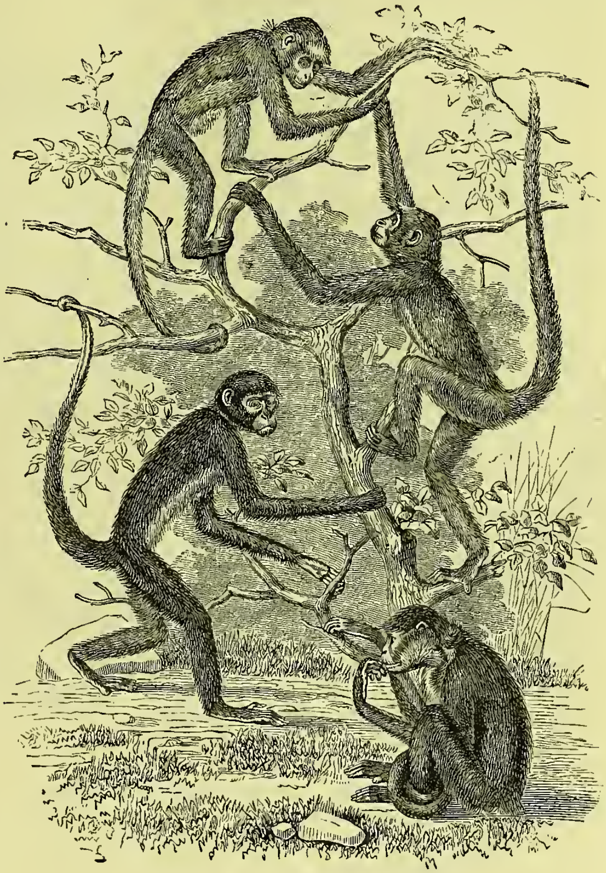
L. infumatus and L. olivaceus are two species described by Spix, and L. castelnaui has been described by J. Geoffroy, but is perhaps only a variety of L. infumatus.

Ateles, or, as some prefer to write it, Atelochirus, includes the Spider monkeys. The head is round, face perpendicular, extremities slender and very long, thumb either rudimentary or wanting, the tail towards the tip naked below. The species are met with over the whole area of the sub-family. Some divide the species having the fur dry and harsh, and having the hair on the forehead directed forward, from those in which the fur is soft and silky, and the hair of head turned backwards. The first would form the genus Ateles, the latter the genus Eriodes; the species of the latter would then be somewhat intermediate between the genera Lagothrix and Ateles. These monkeys are slow in their motions, but make great use of their prehensile tails, by which they swing themselves from bough to bough, moving suspended beneath the boughs, not walking on them. They are able at times, and for short periods, to walk erect on their hind legs. Writing of Ateles variegatus, Wagner (the A. Bartletti of Gray), Mr. E. Bartlett says: "During my four years' sojourn on the Upper Amazons I only met with two species of spider monkeys—this, and R. ater. On my arrival in Peru in 1865, Mr. Hanxirch told me of the existence of a large species of Ateles which he had killed, but failed to preserve. He told me that he met with it on the Rio Tigri, a small tributary that runs into the Amazons about four miles above the town of Nanta, on the north-western shores of the Peruvian Amazon. He said that during the fourteen years he had traded he never found this species in any other locality. On my return from the River Ucayali, in September, 1865, I wished to ascend the Rio Tigri in pursuit of this monkey, but was obliged to abandon the idea on account of the prevalence of fever and ague at that season; and, moreover, the Indians were unwilling to join me in so dangerous a country. Having then determined to spend some few months in the mountain country, I passed up the Marañon and Huallaga to Yurimaguas, and so on to Xeberos, whence I went on to the town of Chyavitos, in the mountains. Having heard that this large monkey was to be met with



SPIDER MONKEYS AT HOME.

in this little-known locality, I remained at Chyavitos about two months; and during that time I became well acquainted with the Indians, who informed me that a long-armed ape (called in the Inca language Urcu Maci-suppah, or Quillu Maci-suppah) was to be met with at a distance of three or more days' journey. I engaged three active Indians, and started by way of a forest foot-road that had been opened by a Catholic priest to the town of Moyabamba as part of his penitence. At the end of three days I reached the highest point of the mountains; here we came across a number of the monkeys in question—about eight or nine. I shot the male that is now in the British Museum; my Indian brought down another with the poison-dart. Having obtained two of them, I felt perfectly satisfied that I had discovered a new species. While, however, I was busily engaged preparing the finest specimen, my Indians had quietly placed the other on the fire. To my great horror and disgust they had singed the hair off, and thus spoiled my second specimen. Of course I was obliged to keep peace, for we had not tasted meat for some days before starting from Chyavitos, and this monkey proved a very dainty dish to us all. I was still in hopes of obtaining more specimens in the Munga-Urcu, or Saucepan Mountain (so called from its peculiar shape), but in this, after much hard work, I failed. These monkeys appear to go in small parties, passing through the forest at a rapid pace, feeding on different kinds of berries. The berries I found in the mouth and stomach of the male were similar to the gooseberry in external appearance; they have, however, a large stone inside. These stones appear to pass through them, as I found several in the intestines. On my return to the town, I found an Indian who had arrived from Caukapanas, a small town lying at the foot of the mountains in the Marañon valley, north-east of the town of Chyavitos, who had in his possession a very fine young spider monkey, which proved to be of this species. It was nearly black, but just showing the light golden hair coming on the under side of the body and tail, some few white hairs on the cheeks, and slight golden crest, sufficient to identify the species. I bought it of the Indian, and managed to bring it alive to Yurimaguas, where it died. On my arrival I was informed by some of my old Indians that they discovered this monkey during my absence on the Upper Huallaga (on the south-eastern shores). One of the Indians said that he brought three young ones alive, which died soon after his arrival in the town. I here give an idea of the great range this monkey inhabits, owing to the ease with which a beast that can use his long arms and tail may travel a country of this description. It is found on both sides of the Peruvian Amazon (or Marañon), on both shores of the Huallaga, and in the interior forest near the



SPIDER MONKEYS (*Ateles melanochir*).

town of Chamicuros. I was told by some of the oldest Indians that these animals are common in the dense forest on the hills near the latter town, their range running between the Huallaga River and Ucayli River to the head-quarters of the Huallaga, between the towns of Lamas and Sarayaçu. Here they occupy the interior forest, and appear to be common, according to accounts given me by Indians of that country, as also on the lower spurs of the mountains between the town of Moyabamba and the Huallaga River. Then again on the Rio Tigri, north-western shores of the Great Marañon, there is not the slightest doubt that this species is to be found ranging along the lower spurs of the Andes, across Ecuador and Columbia, over the head-waters of the Rio Napo, Rio Japura, and Rio Negro, where Natterer first discovered it."

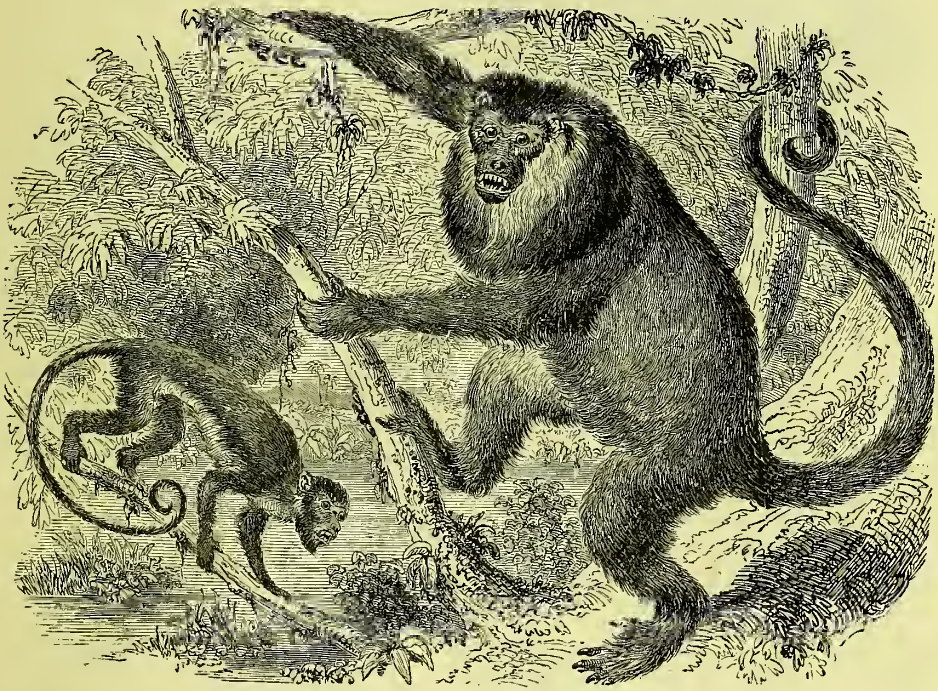
The Black-faced Spider Monkey (*A. ater*) inhabits the forests on the Ucayali, Chamicuros on the Huallaga River, and is found over the whole of the valley of the Amazons, generally keeping to the low ground, and coming as far north as Panama. This is the only species obtained in large numbers by the Indians, who frequently keep them as pets. They travel in bodies of from thirty to forty.

Of other well-known species we may mention A. paniscus, A. rufiventris (from Atrato River) A. grisescens, A. cucullatus, A. melanochir, A. belzebuth, A. villerosus. A. arachnoides has the hair woolly soft; that on the head is short and directed backwards, so that it would belong to the sub-genus Eriodes. This species is restricted to the great timber-bearing regions of Brazil south of the Equator.

SUB-FAMILY 2.—THE HOWLERS (*Mycetinæ*).

This sub-family contains but a single genus, that of Mycetes, or the Howlers. Their throat is swollen, the windpipe is dilated, the hinder part of the lower jaw is much dilated, the hyoid-bone is expanded into an ample resonant brilla. The species of this genus are generally abundant. They are large heavy animals, with a powerful and perfect prehensile tail. They range from East Guatemala to Paraguay. In some species the sexes vary in colour. They are semi-nocturnal in their habits, uttering their cries late in the evening, and before sunrise, and also at the approach of rain. Wallace assures us that the tremendous noise made by a flock is not caused by a great number of performers, but that only one individual makes the howling, which is of a remarkable depth and volume, and curiously modulated; but on closely remarking the suddenness with which it ceases and again commences, it is evident that it is produced by one animal, which is generally a full-grown male. Bartlett tells us that the Golden Howler (*M. seniculus*), sometimes to be seen in the Zoological Gardens, furnishes the principal animal food used by the inhabitants of the borders of the Rivers Huallaga and Ucayali. This species keeps to the low lands and the shores of the rivers, always travelling in pairs. When one is shot, it always hangs to the tree, even if quite dead, and does not fall down until some hours afterwards, when the muscles become relaxed. Therefore, if fresh food is an immediate object, it is better to kill a Lagothrix, in which this peculiarity does not occur. Here we may remark that it is only in the New World that monkeys are used as an article of food.

The Black Howler (*M. villosus*, Gray), said to be from Brazil, is apparently really found in Guatemala, and of it Mr. Salvin writes:—"The Mycetes of Guatemala is commonly known as the 'Mono.' It is abundant throughout the virgin forests of the eastern portion of the republic, but is unknown in the forest-clad slopes which stretch towards the Pacific Ocean. In the former region it is found at various altitudes over a wide expanse of country. I have heard its cry on the shores of the Lake of Yzabal, and all through the denser forests of the valley of the River Polochic it is very common, from the steep mountain-road which lies between the upland village of Purulá and S. Miguel-Tucura, and especially in the wilderness of uninhabited forest which stretches from Teleman to the Lake of Yzabal. In the unbroken forest-country which occupies the whole of the northern portion of Vera Paz from Coban and Cahabon to the confines of Peten, it is also abundant, for seldom an hour passes but the discordant cry of the Mono strikes upon the ear of the traveller as he treads the lonely path to Peten. The elevation of this district varies from about 700 to 3,000 feet; and the Mycetes is found at all heights. When travelling through this forest in 1862, I was dependent for the animal food to supply my party of Indians entirely upon my gun; and Monos contributed not a little to the larder. The Indians eat monkey without demur, but the meat looks dark and untempting. For my own part, I far preferred the delicate Tinamon or Curassow, a sufficient supply of which never failed for my own consumption. Perhaps there is no district in Vera Paz where 'Monos' are more abundant than the mountains of Chilasco, a cold and damp region, elevated at least 6,000 feet above the sea, but where the forest-growth is of the densest description, and trees of the largest size abound. It was here that the specimens were obtained that are now in the British Museum. The wonderful cry whence Mycetes gets its trivial name of Howling Monkey is certainly most striking; and I have sometimes endeavoured to ascertain how far this cry may be heard. It has taken me an hour or more to tread the forest undergrowth from the time the cry first struck my ear to when, guided by the cry alone, I stood under the tree where the animals were. It would certainly not be over-estimating the distance to say two miles. When the sound came over the Lake of Yzabal unhindered by trees, a league would be more like the distance at which the Mono's cry may be heard. These animals are found in small companies of five or six. They are usually met with in the upper branches of the highest trees, and, when disturbed, crawl sluggishly along the boughs. The young, as well as the females, are of the same dense black as the old males, but the hair is shorter, and not so glossy."



THE ARAGUETO (*Mycetes ursinus*).

The Aragueto (*M. ursinus*), of which a figure is given, is met with in Brazil.

Other species are—M. caraya, M. Beelzebul, M. auratus, from Brazil; M. palliatus, from Caraccas.

Sub-Family 3.—The Sakis (*Pithecinæ*).

This sub-family contains about a dozen species, which are to be met with in the great equatorial forests of South America. The tail is non-prehensile, sometimes very short and bushy.

In the genus Pithecia the chin has often a broad beard; the head and neck are short; the crown of the head has hair like a wig, divided by a central longitudinal line; the lower cutting teeth are shelving. The monkeys belonging to this genus are called Couxios and

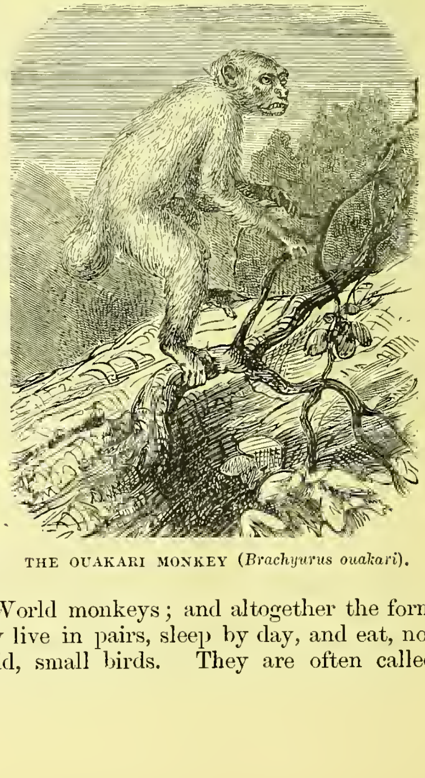
Sakis, and are gregarious, slow, sorrowful-looking creatures; they are also great eaters, and utter loud cries.

The Couxio, or Red-backed Saki (*P. chiropotes*), is agile, wild, and very difficult to tame. When irritated, it assumes an erect posture, grinds its teeth, rubs the extremity of its beard, and jumps around the object of its dislike. Humboldt says he has seen it in its fury drive its teeth into thick boards. Nothing enrages this monkey so much as wetting its beard. In drinking, other American monkeys bring their lips to the liquid; this creature inclines its head upon its shoulder, lifts the water in the hollow of its hand, carries it in this way to its mouth, and drains it with great deliberation. Humboldt thinks that this mode is adopted to prevent the wetting of the beard, which could not be avoided were the water imbibed in the usual way. It is found in Guiana.

THE BEARDED SAKI (*Pithecia satanas*).

Humboldt's Saki (*P. monachus*). This rare monkey is but rarely brought to this country. It is to be met with on the Amazons. Of the other species, we can only mention by name P. leucocephala (Guiana). A specimen presented to the Zoological Gardens, London, in 1800, by Mr. W. H. Barton, was stated to have been procured from the Buck Indians of Demerara, by whom it had been brought from a locality about 300 miles distant in the interior of that country. P. albicans (Upper Amazons and Lake Tefle, Bates); P. rufiventer (Brazil); P. satanas (Lower Amazons); P. ater (Brazil).

In the second genus, Brachyurus, the fur is short and silky; the short hairs on the crown and forehead are directed forwards; the chin is scarcely bearded; the tail is sometimes very short and even bushy, always much shorter than the body. Both B. cebus and B. rubicunda are found in Brazil. B. ouakari, from the forests of the Rio Negro, has been brought to London, and was living in the Zoological Society's Garden in 1870.



THE OUAKARI MONKEY (*Brachyurus ouakari*).

Sub-Family 4.—The Douroucoulis (*Nyctipithecinæ*).

The monkeys of this sub-family are small and elegant little creatures, with long, hairy, and non-prehensile tails.

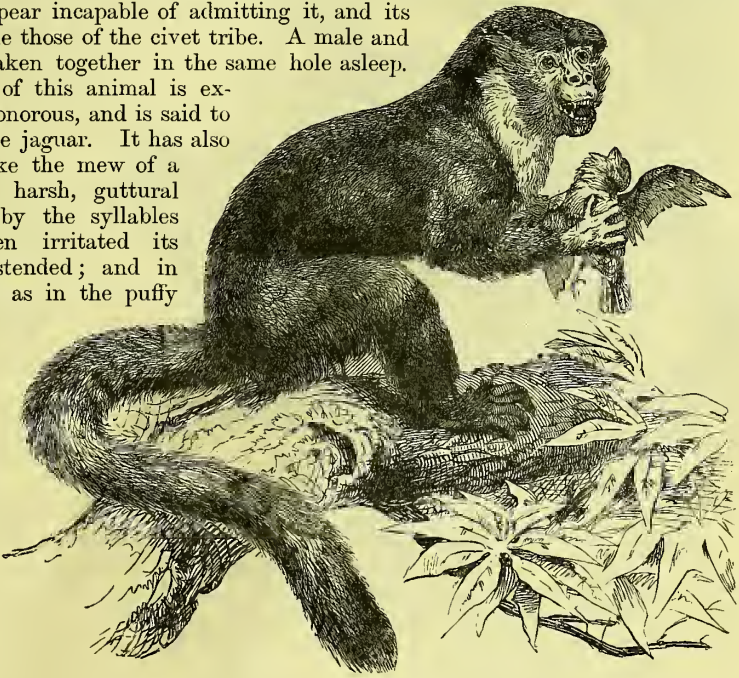
The first genus, Nyctipithecus, contains a few species of large-eyed nocturnal monkeys, to be found ranging from Nicaragua to the Amazon and Eastern Peru. In this genus the two middle upper incisors are broad, but they form a regular series with the canines. The ears are partly hidden amongst the hairs of the head; the hind feet are longer than the fore feet; the tail is longer than the body; the orbits are very large; the nostrils are small, close together, something like those in the Old World monkeys; and altogether the form resembles somewhat the Lemurs. They generally live in pairs, sleep by day, and eat, not only fruit, but also insects, and even, it is said, small birds. They are often called Douroucouli.

The feline Douroucouli (*N. felinus*) is greyish-brown above, and pale rufous below; there is a whitish triangular mark over each eye, bounded by an intervening mark of black, ascending from the base of the nose, and another running from the angle of the mouth, and passing the outer angle of the eye. The form is slender, the palms are flesh-coloured, the face dusky, and the nails black. The length of the head and body is thirteen inches, that of the tail eighteen inches.

It is nocturnal in its habits, and sleeps during the day. Greatly annoyed by the light, it seeks the hollow trunks of trees and similar dark places for concealment. When roused it is dull and oppressed, and can scarcely open its large white eyelids. Its attitude is crouching when it is in repose.

On the approach of dusk all its lethargy vanishes, and it becomes restless and impetuous, roaming about in quest of insects and small birds. It moreover feeds on various fruits, seeds, and vegetables. It glides cat-like through apertures so narrow as to appear incapable of admitting it, and its movements resemble those of the civet tribe. A male and female are often taken together in the same hole asleep. The nocturnal cry of this animal is extremely loud and sonorous, and is said to resemble that of the jaguar. It has also a kind of mew, like the mew of a cat, and a deep, harsh, guttural note, represented by the syllables *quer, quer.* When irritated its throat becomes distended; and in its posture, as well as in the puffy state of its fur, it resembles a cat attacked by a dog. It is found in Southern Brazil.

Of the other species we may enumerate N. trivirgatus, from Guiana; N. lemurinus, from Colombia and Santa Fé de Bogota; and N. rufipes, from Nicaragua, described by Dr. Sclater in "Proceedings of the Zoological Society" for 1872, p. 3, with a very beautiful figure.



THE COLLARED TEETEE (*Callithrix torquatus*).

The genus Saimaris (Chrysothrix) contains but three species. These Squirrel Monkeys are active little creatures, found in most of the tropical forests from Costa Rica to Brazil and Bolivia. The Central American form is S. entomophaga. The fur is soft and close; the tail is elongate, cylindrical, and very slightly prehensile; the canine teeth are large, and the first molar tooth is larger than the rest. S. usta is from Brazil; S. sciurea is often to be seen in collections from Guiana; S. œrstedi, is from Central America.

The last genus is Callithrix. The species of this genus are somewhat intermediate between the last two genera, and are found all over South America, from Panama to the southern limits of the great forests. The tail is covered with short hairs; the canines are moderate; the septum of the nose is nearly as broad as the cutting teeth; ears large; face and orbits moderate; eyes looking forward. They are diurnal in their habits, are gregarious, agile, and live on fruit, insects, and birds' eggs. Only two species of this genus, so far as we can discover, have as yet been brought to these countries. They are called Teetee.

The Collared Teetee (*C. torquatus*) is represented in the above woodcut. It is of a dark reddish-black brown; hair red below, with black tips; crown dark; a narrow margin to face is white, with a narrow reddish-white collar round the neck; the hands are white, the feet black; the tail is black, with hair red at the lower part. It inhabits Brazil.

There are ten other species known—C. cuprea (Ega), Bates; C. amictus (Guiana); C. donacophilus (Bolivia); C. moloch (Brazil); C. ornatus (New Granada); C. personatus, C. nigrifrons, C. castaneoventris, C. gigo (Brazil); C. melanochir (Bahia).

FAMILY V.—THE MARMOSETS (*Hapalidæ*).

This family contains the Marmosets—delicate and timid animals. The molar teeth are, as in the Old World monkeys, thirty-two, but while they possess one less pre-molar tooth in each jaw than the monkeys of the previous family, they have the same number of true molars. The face is broad; the nostrils are severed by a broad septum, and open laterally; the thumb is not opposable, and all the digits have sharp claws; the tail, while it is long, is not prehensile. These small monkeys live together in the great tropical equatorial forests of South America, going in numerous troops. They feed on insects and fruit, and jump, squirrel-like, among the trees. There are two genera, Hapale and Midas, though some prefer to unite all the species under the first-named genus. In Hapale we find the lower incisors long, narrow, convex outwards; while in Midas the lower incisors are short and broad. Perhaps the best-known species is the Common Marmoset (*H. jacchus*). It is met with in Southern Brazil. It is often to be seen in collections, and has bred in confinement. It seems very speedily to become a favourite, and we have known one after a few hours' restraint become playful and familiar. In length it is about eight inches; that of the tail is about eleven. The general shade of the fur is a greyish-olive, almost approaching to black on the head and shoulders; the lower part of the back and tail are barred or ringed with circles of a rich pale grey; the face is flesh-coloured, with a white spot on the forehead; and two tufts of pale or greyish-white hair of considerable length spring out around each ear. A traveller on the Essequibo writes of one that had been made a pet of:—"Nothing pleased him better than to perch on my shoulder, when he would encircle my neck with his long, hairy tail, and accompany me in all my rambles. His tail formed a not very agreeable neckcloth, with the thermometer above one hundred degrees; but he seemed so disappointed when I refused to carry him, that it was impossible to leave him behind. One reason of our intimacy was, that our pursuits were the same, inasmuch as both were entomologists; but he was a far more indefatigable insect-hunter than myself. He would sit motionless for hours among the branches of a flowering shrub or tree, the resort of bees and butterflies, and suddenly seize them when they little suspected danger. Timid in the presence of others, Jackowinki would usually fly to the branches of a neighbouring tree at their approach, uttering a plaintive cry, more resembling that of a bird than an animal. He was apt to be troublesome, even to me, unless, I found him some amusement. This, fortunately, was not difficult."

THE COMMON MARMOSET (*Hapale jacchus*).

Audouin assures us, speaking from his own experience, that the Marmosets not only recognise their own image in a picture, but also that of any other animal. Thus the figure of a cat, and what is more remarkable still, of a wasp, causes them great alarm, while the sight of an insect, such as a grasshopper, impels them to attack the object represented. One of two monkeys belonging to Audouin happened, while eating some grapes, to shoot into his eye a little of the juice, and from that time he never failed to shut his eyes when partaking of this fruit. Both of these monkeys showed great dexterity in catching the flies that occasionally entered their cage; but one day a wasp approached a morsel of sugar that was put between the bars. As they had never seen such an insect before, they could not know by experience the danger of the sting, but instinct gave them a warning, and they retreated as soon as possible to the bottom of the cage. Astonished at these signs of terror, Audouin placed a wasp close to the two monkeys. As soon as they saw it, they covered their heads with their hands, pressed their eyelids, and frowned in such a manner as almost entirely to close their eyes. On the contrary, when he presented a grasshopper, or any other insect from which they had nothing to fear, they immediately seized it, and devoured it with evident delight.

They liked sugar very much, and also baked apples and eggs, which they knew how to break cleverly, for the enjoyment of their contents. But they always refused almonds, acid fruits, and leaves eaten in salad. They did not like meat, but when a little bird was put alive into their cage, they eagerly attacked it, sucked out the brain, and licked the blood; and sometimes they would eat the beak of a bird, the tendons of the feet, and other parts that were not fleshy.

Audouin also remarks that they were of a very prying disposition, that their sight was remarkably piercing, and that they adhered to the habits of their former state. They were very capricious, and were well acquainted with the persons who had charge of them. Their cries varied according to the passions that actuated them. When they were frightened, their yelping seemed to proceed from the gullet, for they opened their mouths, and showed their teeth. When they were angry, they emitted a sort of low hissing sound, followed by a kind of croaking. In other circumstances, as when in the open air, they uttered long hissings, and called one another with a kind of warbling, similar to that of birds.

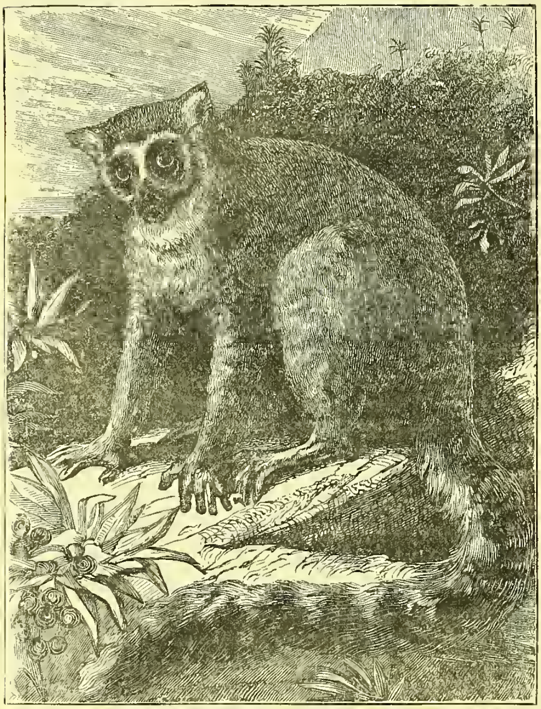
THE AVAHI (*Microrhynchus laniger*).

Of the species of Hapale, H. melanura, H. penicillata, H. melanura, and H. chrysoleucos, are all from Brazil, and have lived in the London Gardens; while H. aurita has also been described. Midas is a genus containing some two dozen species, several of which are to be seen in zoological gardens; the Pinche Monkey, found in New

Granada; M. chrysomelas, M. rosalii, M. flavifrons, M. bicolor, and M. rufiventer, are all described from Brazil; M. mystax is from Peru; and M. Geoffroii, from Chepo, on the Isthmus of Panama.

SUB-ORDER II.—THE LEMURS (*Lemuroidea*).

This sub-order differs in very many respects from the first sub-order of the Primates. More than fifty species of the Lemurs are now known. Their home is chiefly in Madagascar, though a few species live on the continent of Africa, others in the warm regions of Asia, and in the Indian Archipelago. From the Anthropoidea, they are distinguished among other things by having their lower jaw remaining permanently divided in the middle, by the orbits being open behind, and not being separated from the temporal fossæ by the great wings of the sphenoid bones. Of this sub-order there are three families:—



THE RING-TAILED LEMUR (*Lemur catta*).

FAMILY VI.—THE LEMURIDÆ.

In this group the upper incisor teeth are four, in pairs. The fingers and toes are full and well developed, the first toe shorter; claw of the second subulate, of the first long and curved, the others flat. Professor Mivart divides this family into four sub-families:—

Sub-family 1.—The Indri (*Indrisinæ*).

This contains the genus Indris; the head is elongate, the face is rather produced, the ears are prominent, hairy, and the tail is short or rudimentary. The great toe is very long, slender, and covered with hair; the feet are short. But one species, I. brevicaudatus, from Madagascar, is known.

In the genus Propithecus, the tail is long; the ears are short and smooth inside. In the best-known species, P. diadema, the fur is formed of long, straight, silky hairs; the head, nose, and top of the back are black; the forehead, ears, chest, and tail are yellowish-white; the shoulders, sides, and belly white; the lips are black. Like all the other species of this sub-family, it comes from Madagascar.

In the third genus, Microrhynchus, the head is short and sub-globose; the face is short and pointed; the eyes large; the ears small and hairy, and hidden. The Avahi (*M. laniger*) is found in Madagascar. (See figure on previous page.)

Sub-family 2.—The True Lemurs (*Lemurinæ*).

In this sub-family we find the following genera:—Lemur.—The muzzle is elongated, ears exposed, sometimes pencilled. In some the face is furnished with a ruff. Among the species we may mention L. ruber and L. albifrons. The former is rare; the latter has been several times brought to this country. The mongoose (*L. Mongoz*) is, perhaps, the commonest species, and that oftenest seen in collections. It has bred in the London Zoological Gardens. Among other species brought to this country may be mentioned L. varius and L. macaco (the Black Lemur). The writer had a specimen of this latter brought to him while residing at the Seychelles from Nozebé. It speedily became a great pet, sleeping the most part of the day. About sunset, our dinner-time, it woke up to activity, and when the verandah was adjourned to for fruit and coffee, the little creature was sure to be found perched at the back of my chair or on my shoulder. It was a gentle, pleasant-mannered, wee thing, very fond of the small yellow finger bananas, which I used to share with it. It would take also a morsel of biscuit steeped in milk. Sometimes after a hard day's work the sun would rise, and find me in bed, and on such occasions the Lemur was sure to be found perched on my pillow, having got in under the mosquito curtains. It seemed to enjoy its life, until one day I added to my collection a young leopard (*Felis pardus*) from Zanzibar. This creature was as playful as young, and used to frighten the lemur horribly. If the lemur found the leopard loose on the verandah, nothing for a long time would tempt it to come off the roof even for a bit of fruit. By degrees it acquired a little more familiarity, though it would evince, by a series of half convulsive snortings, the fright it was in. However, the leopard one day nearly caught it, and from that on it took itself to the roof and the adjoining trees. It still always paid me a nocturnal visit, and I always laid by for it a store of things it liked, and it found out by experience that the leopard never came to my bed-room, which was on the second storey. It got, however, so dirty by its wanderings that I took it into my head to wash it, which I did one day with soap and warm water. As luck would have it, just as I had it fully soaped, the leopard broke his cord and came over to me. With one frantic effort the lemur burst from me, and was on the roof of the house ere I could utter a word. It here at once commenced to lick itself all over, doubtless swallowing a lot of soap, which soon made it so sick that it was distressing to see it retching. Unable to reason correctly, it doubtless ascribed all its sufferings to me, became quite wild, and never once, in spite of all my wooings, ever came near me again. When about to leave, I made many efforts to catch it alive to bring it with the leopard to the London Zoological Gardens, but all my stratagems failed. So I was obliged to leave it behind, sorry to think it should think so badly of me. L. brunnens, L. flavifrons, and L. catta (see figure) have been brought alive to London. Altogether about fifteen species of this genus are known, and all are confined to Madagascar.

Hapalemur.—Of this genus we have two species, of neither of which is much known. One, H. simus, is figured on Plate 52 of the "Proceedings of the Zoological Society of London" for 1870; the other, H. griseus, has never been brought to England.

Microcebus.—In this genus Mivart places six species. Buffon's Madagascar Rat would appear to be represented by M. pusillus.

Cheirogaleus and Lepilemur contain but a single species each, C. Milii and L. mustelinus.

SUB-FAMILY 3.—THE SLOW LEMURS (*Nycticebinæ*).

We have here four genera—Nycticebus, Loris, Perodicticus, and Arctocebus.

The Nycticebi are small, short-tailed, stout-limbed, nocturnal animals, called Slow Lemurs. The slow lemur (*N. tardigradus*) is found almost always living in trees, prowling abroad at night, and preying on sleeping birds, on mice, and insects, which it approaches unawares, and seizes before they are sufficiently roused to notice its proximity; they would otherwise readily make their escape from an animal so tardy in its movements. When it fails in procuring these, it has recourse to fruits, on which it thrives very well in captivity. In its motions it is excessively slow and languid. When on the ground, its posture is constrained and unnatural, and it rather drags itself along than walks. On a tree, or in mounting the bars of a cage, it seems more at ease, but still moves with tardy and cautious regularity. Grasping a branch or a bar in the first place tightly with one of its fore paws, it gradually fixes the other, and then advances its hinder hands with equal slowness and precision, never quitting its hold with the one until it has ascertained the firmness of its grasp with the other.

Its nocturnal and unobtrusive habits account, in some degree, for the rarity of its appearance. It seems, however, to be widely spread, having been found in Bengal, Assam, Arracan, Borneo, and Sumatra.

The celebrated Oriental scholar, Sir William Jones, has given us an interesting account of one of these lemurs. "He was usually gentle, except in the cold season, when his temper seemed wholly changed; and his Creator, who made him so sensible of cold, to which he must often have been exposed even in his native forests, gave him, probably for that reason, his thick fur, which we rarely see on animals in these tropical climates. To me, who not only constantly fed him, but bathed him twice a week in water accommodated to the seasons, and whom he clearly distinguished from others, he was at all times grateful; but when I disturbed him in winter he was usually indignant, and seemed to reproach me with the uneasiness he felt, though no possible precautions had been omitted to keep him in a proper degree of warmth. At all times he was pleased with being stroked on the head and throat, and frequently suffered me to touch his extremely sharp teeth; but his temper was always quick; and when he was unseasonably disturbed, he expressed a little resentment by an obscure murmur, like that of a squirrel, or a greater degree of displeasure by a peevish cry, especially in winter, when he was often as fierce, on being much importuned, as any beast of the woods.

"From half an hour after sunrise to half an hour before sunset, he slept without any intermission, rolled up like a hedgehog; and, as soon as he awoke, he began to prepare himself for the occupations of his approaching day, licking and dressing himself like a cat—an operation which the flexibility of his neck and limbs enabled him to perform very completely. He was then ready for a slight breakfast, after which he commonly took a short nap; but when the sun was quite set he recovered all his vivacity.

"His ordinary food was the sweet fruit of India—plantains always, and mangoes during the season; but he refused peaches, and was not fond of mulberries, or even of guavas; although he lapped milk eagerly, he did not object to plain water.

"Generally, he was not voracious, but of grasshoppers he never could have enough; and he passed the whole night during the hot season in prowling for them. When a grasshopper, or any other insect equally palatable, alighted within his reach, his eyes, which he fixed on his prey, glared with uncommon fire, and having drawn himself back to spring on it with greater force, he seized the victim with both his forepaws, but held it in one of them only while he devoured it.

THE POTTO (*Perodicticus potto*).

"For other purposes, and sometimes even for that of holding his food, he used all his paws indifferently as hands, and frequently grasped with one of them the higher part of his ample cage, while his three others were severally engaged at the bottom of it. But the posture of which he seemed the fondest was that of clinging with all four hands to the upper wires, while his body was inverted. In the evening he usually stood erect for many minutes, playing on the wires with his fingers, and rapidly moving his body from side to side, as if he had found out the utility of exercise in his unnatural state of confinement.

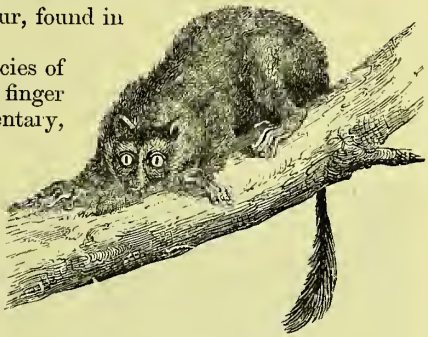
"A little before daybreak," says Sir William, "when my early hours gave me frequent opportunities of observing him, he seemed to solicit my attention; and, if I presented my finger to him, he licked or nibbled it with great gentleness, but eagerly took fruit when I offered it, though he seldom ate much at his morning repast. When the day brought back his night, his eyes lost their lustre and strength, and he composed himself for a slumber of ten or eleven hours.

"My little friend was, on the whole, very engaging; and when he was found lifeless in the same posture in which he would naturally have slept, I consoled myself with believing that he died without much pain, and lived with as much pleasure as he could have enjoyed in a state of captivity." N. javanicus is found in Java, Sumatra, and the Malay Peninsula.

Loris contains but a single species—the Slender Loris (*L. gracilis*). This is a very small tail-less lemur, found in Ceylon and Madras.

The Potto (*Perodicticus potto*) is the only species of the genus; it is found at Sierra Leone. The index finger is rudimentary and nail-less; the tail is rudimentary, not distinct. It sleeps by day, rolled up in a ball, with the head folded between the fore-legs resting on the chest. In the illustration it is represented at night, when it is lively.

Arctocebus calabarensis is a most extraordinary form, from Old Calabar. The tail is very short, the hands and feet are small, with the lower phalanges (not including the thumb) united in the skin, the two upper joints free, the index finger reduced to a tubercle. The student should consult Professor Huxley's memoir of this strange lemur in the "Proceedings of the Zoological Society" for 1864.


THE GALAGO (*Galago demidoffi*).

SUB-FAMILY 4.—THE GALAGOS (*Galagininæ*).

This contains but a single genus, the species of which are confined to the African Continent, ranging from Senegal and Fernando Po to Zanzibar and Natal. The ears are elongate, bald, thin, very contractile on the hinder edge, with an inclination to fold back; feet broad, hind limbs much longer than the fore; face produced, eyes moderate. The tail is long, often bushy.

The Galagos are quiet, inoffensive creatures, living on fruits and insects; perhaps sometimes on small birds. The fourteen or fifteen known species are grouped under four sub-genera by Mivart. We must content ourselves here with stating that, of those brought living to England, we find G. alleni, from Fernando Po; G. crassicaudata, from Port Natal and Mozambique; G. monteiri, Angola; G. garnetti, Port Natal; G. maholi, South Africa; G. demidoffi, which we figure, from the Gaboon. Another pretty species, from Senegal and the Gambia, is G. Senegalensis.

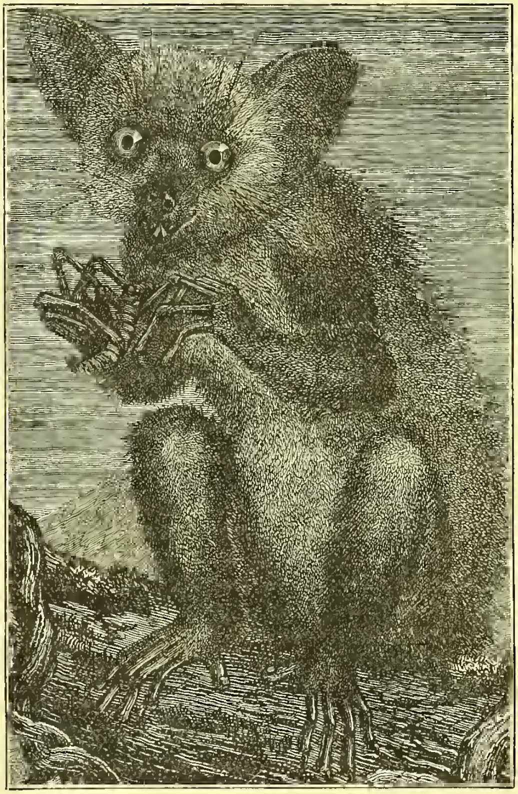
THE TARSIER (*Tarsius spectrum*).

FAMILY VII.—THE TARSIDÆ.

A very graceful little animal, the Tarsier (*Tarsius spectrum*) is the sole representative of this family. It is a small, long-tailed, and long-footed nocturnal animal. It is found in Sumatra, Banca, and Borneo, and also in some parts of Celebes. The fingers and toes are free and well developed: the third on the fore leg, the fourth on the hind leg, the longest; the first and second hind toes shorter, each with an elongate curved claw; the head is short; eyes large; the tarsi of the hind feet are very long, enabling the animal to hop like a frog. It seems to feed chiefly on insects.

FAMILY VIII.—THE CHIROMYIDÆ.

The sole representative of this family is the Aye-aye (*Chiromys madagascariensis*). "It resembles in size," says Professor Owen, "and somewhat in shape, a domestic cat; but its head, especially with the ears, is larger; the hind limbs are longer, and the tail still more so in proportion to the body." The colour of its back, flanks, tail, and limbs is a dark grey, approaching to black, which changes into a light brown upon the belly and inner side of the arm and thigh, and lightens into yellowish-grey upon the throat and sides of the head. "The eyes are prominent, directed forwards, their openings round, exposing only the cornea and iris, which is of a light brown hue, and by daylight reducing the pupil to the size of a pin's head. The ears are large, and appear, on examination of their muscles, to be endowed with the power of much and varied movement; when at rest they usually stand out horizontally, adding greatly to the breadth of the head. The hand is prehensile, having a thumb which is opposable to the other fingers. "But," says Professor Owen, "the most singular feature of the hand is the attenuated middle finger, which seems as if stricken and withered by palsy." The animal can freely separate and approach the digits, the longest of which measures about three inches, for a variety of purposes. Another peculiarity is the great size and unusual shape of the teeth. They consist only of molars and incisors. It has quite recently been stated the Aye-Aye constructs a nest for itself among the branches of the trees on which it lives. This most interesting fact would find an equivalent among the nest-building rodents.



THE AYE-AYE (*Chiromys madagascariensis*).

Dr. Sandwith tells an interesting story of one he had in captivity. "The thick sticks I put into his cage were bored in all directions by a large and destructive grub, called the *Montouk*. Just at sunset the Aye-Aye crept from under his blanket, yawned, stretched, and betook himself to his tree, where his movements are lively and graceful, though by no means so quick as a squirrel. Presently he came to one of the worm-eaten branches, which he began to examine most attentively; and bending forward his ears, and applying his nose close to the bark, he rapidly tapped the surface with the curious second digit, as a woodpecker taps a tree, though with much less noise, from time to time inserting the end of the slender finger into the worm-holes, as a surgeon would a probe. At length he came to a part of the branch which evidently gave out an interesting sound, far he began to tear it with his strong teeth. He rapidly stripped off the bark, cut into the wood, and exposed the nest of a grub, which he daintily picked out of its bed with the slender tapping-finger, and conveyed the luscious morsel to his mouth. But I was yet to learn another peculiarity. I gave him water to drink in a saucer, on which he stretched out a hand, dipped a finger into it, and drew it obliquely through his open mouth. After a while he lapped like a cat; but his first mode of drinking appeared to me to be his way of reaching water in the deep clefts of trees."

A beautiful specimen was brought living to the London Zoological Gardens in 1862.

ORDER II.—WING-HANDED ANIMALS (*Cheiroptera*).

THIS order contains a large number of flying Mammals, well known under the name of Bats. Their fore limbs are specially modified for flight. The fore-arm consists of a rudimentary ulna, and a long, curved radius; there are six carpal bones, which support a thumb and four immensely elongated fingers. Between these fingers a thin expansion of the integument, called the wing-membrane, is spread out. By means of this membrane they fly. Though these hands are well adapted for flight, they are still capable in a small measure of seizing, differing thus from the anterior limbs in birds. The feet are five-toed, the knee is directed backwards, and one of the bones of the foot (*calcaneum*) supports part of the posterior margin of an accessory membrane of flight, extending from the tail to the hinder limb. This is called the interfemoral membrane. The incisor teeth vary in number. The canines are distinct. The molars are equally enamelled, and are many cusped, or furnished with a depressed crown. The mammæ are two, and pectoral. Bats are for the most part nocturnal, flying about after sunset, though some of the frugivorous bats can fly by day. On the approach of cold in northern climes these species hybernate.

Adopting the nomenclature and divisions of Dr. Dobson, we divide this order into two sub-orders.

SUB-ORDER I.—THE GREAT BATS (*Mega-cheiroptera*).

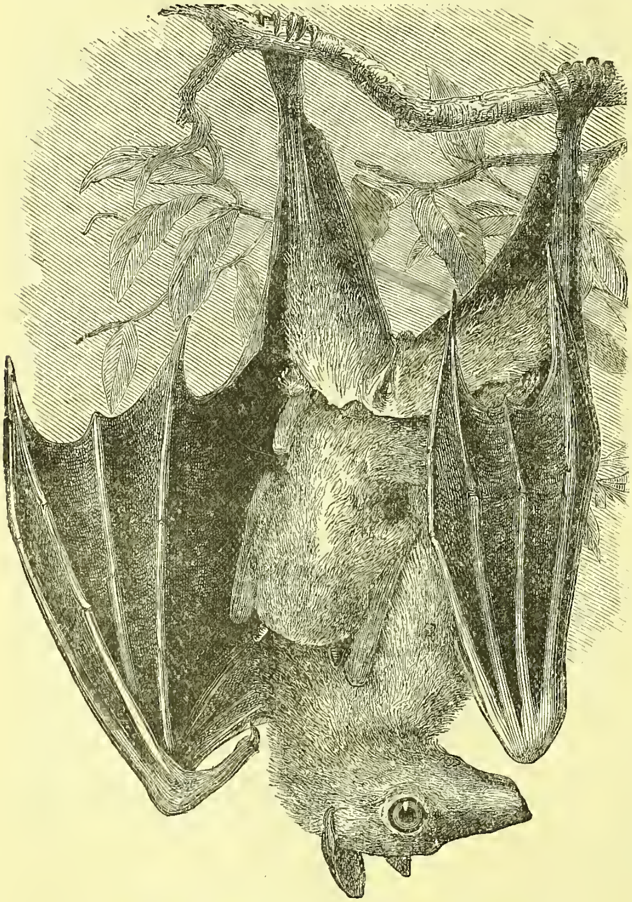
THIS contains the Fruit-eating Bats, and the species are met with in the tropical and sub-tropical regions of the Eastern hemisphere and Polynesia. The crowns of the molar teeth are smooth, marked with a longitudinal furrow; the second, or index-finger, generally terminates in a claw. This sub-order contains but a single family, that of

FAMILY IX.—THE FRUIT-EATING BATS (*Pteropidæ*).

The characters of this family will be the same as those of the sub-order. These fruit-eating bats are often called flying-foxes. They are found over the tropical and sub-tropical regions of the Old World and Australia, and in the Pacific Islands, as far east as the Samoa Group, but are not found in the Sandwich Islands. Nine genera are enumerated by Dr. Dobson—Pteropus, Cynonycteris, Cynopterus, Epomophorus, Harpyia, Cephalotes, Notopteris, Eonycteris, and Macroglossus. The first six form a group, in which the tongue is moderate, but the molar teeth are well developed. In the last three genera the tongue is very long, the muzzle is narrow, and the molar teeth are very narrow and scarcely raised above the gum.

The largest known bat is the Pteropus edulis. This is met with in Sumatra and Java. The adult male sometimes measures twelve inches in length. In the lower parts of Java it is extremely abundant, uniformly living in flocks. Numerous individuals select a large tree for their resort, and, suspending themselves with the claws of their posterior extremities to the naked branches, often in companies of several hundreds, afford a very singular spectacle. They pass the greater portion of the day in sleep, hanging motionless. Ranged in rows, with the head down, the membrane contracted about the body, and often in close contact, they have little resemblance to living beings, and by a person not familiar with them, are readily mistaken for a part of the tree, or for a fruit of uncommon size suspended from its branches. Soon after sunset they gradually quit their roosts, and pursue their nocturnal flights in quest of food. They direct their course by an unerring instinct to the forests, villages, and plantations, occasioning incalculable mischief, attacking and devouring indiscriminately every kind of fruit, from those which surround the dwellings of the meanest peasantry, to the rare and most delicate productions which are cultivated with care by princes and chiefs of distinction. Mr. Marsden, in his "History of Sumatra," informs us "that he has observed very large flights of the Kaluwang (*P. edulis*) passing at a great height in the air, as if migrating from one country to another; and Captain Forrest notices their crossing the Straits of Sunda, from Java Head to Mount Pugong; they are also seen hanging by hundreds upon trees."

P. medius is the "Flying-fox" of Europeans. Wherever fruit is abundant throughout the Indian peninsula (south of the Punjab), this species, the "Flying-fox" of Europeans, is to be found. A colony, consisting of many hundreds of individuals, is often found inhabiting a single large tree, which is so covered that the animals, hanging head downwards, wrapped up in their wings, resemble large dark-coloured leaves. I have often been able to detect their presence on trees at night by the strong musky odour evolved from their bodies, which fills the motionless air, and which is probably due to the secretions of the shoulder-glands. Mr. Francis Day, who has had the opportunity of observing the habits of this species for many years, remarks:—"In their diet they are exclusively frugivorous, and they do very great injury to cocoa-nut plantations and mangoe gardens. Their habits are very intemperate, and they often pass the night drinking the toddy from the chatties in the cocoa-nut trees, which results either in their returning home in the early morning in a state of extreme and riotous intoxication, or in being found the next day at the foot of the trees, sleeping off the effects of their midnight debauch. The wild almond (*Terminalia catappa*), when in fruit, is one of their favourite resorts at night time; they sometimes carry off the almonds into the verandahs of houses, where they extract the kernels, and in so doing frighten nervous people into the belief that robbers are endeavouring to effect an entrance. They are also very partial to wild figs."



THE COLLARED FRUIT-BAT (*Cynonycteris collaris*).
Female and young.

It is the only species of this genus known to inhabit the peninsula of India. It is also met with in Ceylon, Madagascar, Seychelles, and Mauritius. In the Seychelles I have noticed flocks making expeditions from one island to another in broad daylight. Several species have been brought alive to England.

Another little Indian bat, very destructive to fruit of all kinds, is Cynopterus marginatus, which has lived in confinement in the Zoological Gardens in London. Dr. Dobson relates how that he gave a specimen of this little bat a ripe banana weighing two ounces; that it had this devoured in about three hours; and yet, on being killed and weighed that morning, the bat was found to weigh but one ounce!

The pretty collared fruit bat of Natal (*Cynonycteris collaris*) has on several occasions between 1870 and 1875 bred in the London Zoological Gardens.

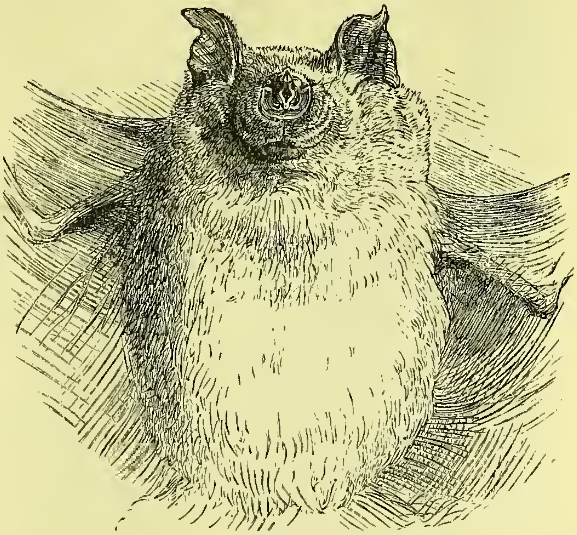
SUB-ORDER II.—THE SMALLER BATS (*Micro-cheiroptera*).

THE bats in this sub-order are chiefly insect eaters, and have the crowns of the molar teeth acutely tubercular and marked by transverse furrows. The index, or second finger, is not terminated by a claw. They inhabit not only the tropical but also the temperate regions of both hemispheres. This sub-order may be conveniently divided into two sections. In the first, the tail is contained within the interfemoral membrane, and the middle finger has two phalanges—here Dr. Dobson placed the families Rhinolophidæ, Nycteridæ, and Vespertilionidæ. In the second, the tail perforates, as it were, the interfemoral membrane, and appears on its upper surface, or it is produced considerably beyond the membrane; the middle finger, when it has two phalanges, has the first phalanx folded (in repose) on the dorsal surface of the metacarpal bone; as in Emballonuridæ, or the middle finger has three phalanges, as in Phyllostomidæ. We must take a glance at each of these families.

FAMILY X.—THE HORSESHOE BATS (*Rhinolophidæ*).

The bats of this family have well-developed foliaceous cutaneous appendages surrounding the nasal apertures. Sometimes these nose-leaves are very curiously developed, as will be seen in Rhinolophus luctus. Their eyes are often so minute that in spirit specimens they can with difficulty be discovered. They reach their highest development and are found in greatest variety and abundance in the tropical and sub-tropical portions of Europe, Asia, Africa, Australia, and the Malay Archipelago. Here we have the genera Rhinolophus and Phyllorhina. The Great Horseshoe Bat (*R. ferrum-equinum*) is one of the largest of the genus, being from tip of tail to nose nearly four inches in length. It is not uncommon in England, is found throughout Europe, in North Africa, in Asia Minor, Syria, and in the Himalaya.

R. luctus is by far the largest of the genus yet discovered, being nearly an inch longer in its body than the Great Horseshoe Bat; its nasal appendages are greatly developed. It is found in the Himalayas, Sikkim, Ceylon, Java, Sumatra. This species appears to be restricted to the highlands of the countries inhabited by it. In the Himalayas the late Captain T. Hutton has found it at an elevation of 5,500 feet, "hanging from the roof of an outhouse in which rabbits and firewood were kept, looking, with its ample black wings folded round it as a cloak, somewhat like a large black cocoon." Captain Hutton's long residence in a region much frequented by this species afforded him rare opportunities for observing its habits; he continues:—"This fine species commences its flight rather early in the evening, and does not soar high, like the smaller bats in general, but remains below, at about twenty to thirty feet from the ground, wheeling, with a somewhat heavy and noiseless flight, around buildings and large trees in search of small beetles and other insects. Indeed, I think it may be truly said of all the larger species of bats, that they hawk for prey in the lower regions of the atmosphere, while nearly all the smaller ones ascend; and the reason is that while the flies and minute insects are in the higher regions, the large beetles and other large insects, of which the smaller bats could make no use, are found below, among the branches of the trees. This species appears usually to dwell in pairs, and does not associate in communities like some of the smaller Rhinolophi, though in a large cavern (affording ample room for them to hang apart) several pairs may sometimes be found. I have taken them from the roofs of outhouses


HEAD OF THE GREAT HORSESHOE BAT (*Rhinolophus ferrum-equinum*).

and in wide caves in limestone rocks; but they appear to fly only during the warmer months of summer, remaining (at least, such is the case at Mussooree) in a semi-torpid state during the winter. It is possible, however, that in the warmer south-eastern climates of Sikkim and the Cossiah Hills they may be active likewise in the winter."

The Lesser Horseshoe Bat (*R. hipposideros*) is met with in Asia Minor, and extends across southern and middle Europe as far west as Ireland, where it has been taken by Professors King and Kinahan. The accompanying figure of the head of an Irish specimen will give some idea of the peculiar nose-leaves. It is not uncommon in England.

Phyllorhina.—Of the species of this genus, which are numerous, we can only mention P. armigera, which is not uncommon in India. It is met with in the Himalayas, Nepaul, and Khasia Hills, also in Ceylon and China. The habits of this species have been attentively observed by the late Captain T. Hutton. He remarks :—" One specimen was captured at an elevation of 5,500 feet, having been attracted one evening in April to the lights in a room; and a pair were also taken in a loft, at 6,000 feet, in September. From this loft, the trap-door being left open, they used to issue every evening about dusk, flying with a slow deliberate flight around the house, and never departing to any great distance. They hawked about only for a short time at intervals, retiring every now and then to the loft. When captured alive, the large ears are kept in a constant state of rapid tremulous motion, and the animal emits a low purring sound, which becomes a sharp squeak when alarmed or irritated. When suspended at rest, the tail and interfemoral membrane are turned up, not in front, like the Rhinolophi, but behind, over the lower part of the back ; neither does it appear to envelop itself in its wings so completely as does Rhinolophus luctus. I have observed in this, and in all the Rhinolophi, that when disturbed the whole of the facial crests are kept in a state of constant agitation, and as the animal hangs suspended by the feet, the head and muzzle are stretched forth and turned about in every direction, as if for the purpose of sniffing out the presence of danger, and ascertaining the cause of the disturbance. Coming out of its retreat before dark, and often, indeed, about sunset during the cloudy and misty weather of the rainy season, it may frequently be seen leisurely wheeling, with noiseless, cautious, and slow steady flight, around some wide-spreading oak, attracted to the spot by the loud discordant note of a large cicada, or tree-cricket, which is abundant at that season in forest-tracts above 5,000 feet, and only pours forth its clamorous evening song just as the sun begins to dip below the horizon. It is during this dreadfully harsh concert, when almost every tree sends forth its stunning notes, that this bat emerges from its hiding-place, wheeling round and round the trees, scanning each branch as he slowly passes by, now rising to a higher circle, and then, perchance, descending to the lower branches, until at length, detecting the unfortunate minstrel, it darts suddenly into the tree, and snatching the still screaming insect from its perch, bears it away."

FAMILY XI.—NYCTERIDÆ.

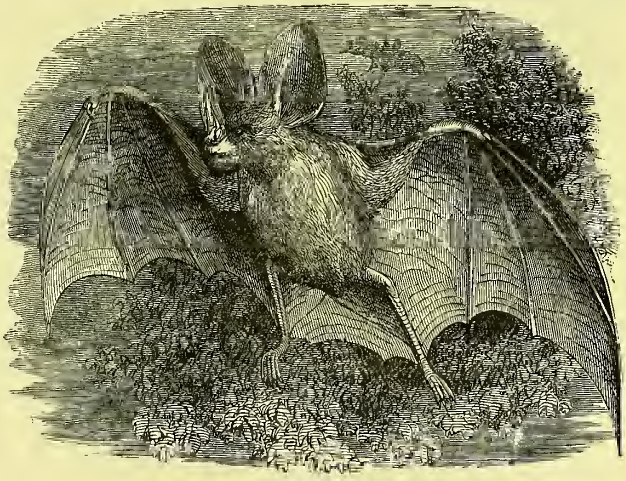
The bats of this family have distinct cutaneous nasal appendages margining the apertures of their nostrils, which are situated on the upper surface of the muzzle. The ears are united, large, with well-developed tragi. They are to be found in Africa, Southern Asia, and the Malays. Dr. Dobson divides it into two sub-families, according to the position of the nostrils. These correspond to the two genera, Nycteris and Megaderma.

Nycteris javanica is the only species met with in Asia, and it is found only in Java. All the rest are African. We give a figure of N. thebaica on the next page. Geoffroy's story that the bats of this genus were able to inflate their skin has been proved by Professor Peters to be founded on error.

Megaderma lyra is found in Asia ; it has been shown by Mr. Edward Blyth to occasionally feed on other than insect prey. " Chancing, one evening, to observe a rather large bat enter an outhouse, from which there was no other egress than by the doorway, I was fortunate in being able to procure a light, and thus proceed to the capture of the animal. Upon finding itself pursued, it took three or four turns round the apartment, when down dropped what at the moment I supposed to be its young, and which I deposited in my handkerchief. After a somewhat tedious chase, I then secured the object of my pursuit, which proved to be a fine pregnant female of Megaderma lyra. I then looked at the other bat which I had picked up, and, to my considerable surprise, found it to be a small Vespertilio, nearly allied to the European V. pipistrellus, which is exceedingly abundant.

not only here, but apparently throughout India, being the same, also, to all appearance, as a small species which my friend Dr. Cantor procured in Chusan. The individual now referred to was feeble from loss of blood, which it was evident the Megaderma had been sucking from a large and still bleeding wound under and behind the ear; and the very obviously suctorial form of the mouth of the vampire was of itself sufficient to hint the strong probability of such being the case. During the very short time that elapsed before I entered the outhouse, it did not appear that the depredator had once alighted; but I am satisfied that it sucked the vital current from its victim as it flew, having probably seized it on the wing, and that it was seeking a quiet nook where it might devour the body at leisure. I kept both animals wrapped separately in my handkerchief till the next morning, when, procuring a convenient cage, I first put in the Megaderma, and after observing it some time, I placed the other bat with it. No sooner was the latter perceived, than the other fastened on it with the ferocity of a tiger, again seizing it behind the ear, and made several efforts to fly off with it, but finding it must needs stay within the precincts of the cage, it soon hung by the hind legs to one side of its prison, and, after sucking its victim till no more blood was left, commenced devouring it, and soon left nothing but the head and some portions of the limbs. The voidings observed very shortly afterwards in its cage resembled clotted blood, which will explain the statement of Stedman and others concerning masses of congealed blood being always observed near a patient who has been attacked by a South American vampire. Such, then, is the mode of subsistence of the Megaderma. The sanguinivorous propensities of certain bats inhabiting South America have long been notorious, but the fact has not heretofore been observed in the Old World; and the circumstance of one kind of bat preying upon another is altogether new, though I think it not improbable that the same will be found to obtain (to a greater or less extent) among the larger species, if not throughout the whole extensive allied genus of Rhinolophus (or

THE NYCTERIS THEBAICA.



THE MEGADERMA FRONS.

horseshoe bats), which, like Megaderma, are peculiar to the Eastern world." And Dr. Dobson thinks it highly probable that none of the species of this genus confine themselves to insect prey alone; but that all feed when they can upon the smaller species of bats or other small mammals. Two species are Asiatic and two are African.

FAMILY XII.—VESPERTILIONIDÆ.

The bats of this family are easy distinguished by having simple nostrils, which terminate the conical, moderately-long snout; by having a long tail, wholly contained within the interfemoral membrane; and by the upper incisors being separated by a wide space and placed near the canine teeth. The eyes are minute, and the inner margins of the ears arise from the sides of the head and not from the forehead. The species are generally distributed throughout the temperate and tropical regions of both hemispheres. In one group the upper incisors are close to the canines; and here we have the Plecoti, with ears very large and united, and the Vespertiliones, with the ears moderate and separate. In the second group we have the upper incisors separated from the canines, and also in front.

Dr. Dobson enumerates eighteen genera. We here can only mention the following:—Vespertilio mystacinus—the Whiskered Bat. Though rare and local in England, it is common in Belgium, and extends across Europe to Russia, and from the Alps to Finland. It is also found in Nepaul, and probably extends through the whole range of the Himalayas.

Vesperugo pipistrellus, the Pipistrelle, is the common bat of the British Islands. From the middle of spring, but earlier or later, according to the warmth of the season, to the middle of October, the Pipistrelle may be seen after sunset, in the neighbourhood of towns and villages, over the roads or streets of cities, in the alleys and lanes, or along the course of brooks and rivers, fluttering with an unsteady motion, and apparently undetermined course. Its flight is not rapid, like that of a bird, but rather resembles that of a large moth or butterfly. It turns and winds in all directions, flying at various heights, from ten to twenty or more feet, and sometimes as high as the tops of the trees, but more commonly at an elevation of about fifteen feet.

The Pipistrelle is a twilight rambler. Remaining concealed during the day, it may be observed to begin its flight as the dusk of evening advances, in chase of moths and other insects, skimming the water like a swallow, darting through the sombre foliage of the trees, or wheeling round the barn, and it may be heard repeatedly uttering its sharp shrill cry of pleasure or delight.

It is, however, during the fine calm evenings of summer that the activity of this little winged creature attains its highest pitch. Then it passes up and down, in and out of any open building, now near to the spectator, and then at a distance, with surprising rapidity; for now flies of various kinds may be seen assembled in vast troops, alternately rising and falling in the air, so as to exhibit a pleasing spectacle. These insect-dances are kept up from about an hour before sunset until the dew begins to fall. Sometimes they swarm in infinite myriads, and appear in the sunbeams as numerous and more lucid than drops of rain, and as if the sky were showering down brilliant gems. At other times, from some peculiar state of the atmosphere, the insects at a distance look much larger than they really are, and appear so transparent and brilliant as scarcely to resemble anything material.

White, in his delightful "History of Selborne," says of this bat:—"I was much entertained last summer with a tame bat, which would take flies out of a person's hand. If you gave it anything to eat, it brought its wings round before the mouth, hovering and hiding its head in the manner of birds of prey when they feed. The adroitness it showed in shearing off the wings of the flies, which were always rejected, was worthy of observation, and pleased me much. Insects seemed to be most acceptable, though it did not refuse raw flesh when offered; so that the notion that bats go down chimneys and gnaw men's bacon, seems no improbable story."

It is to be found throughout Europe and its islands, and in the temperate regions of Asia north of the Himalayas.

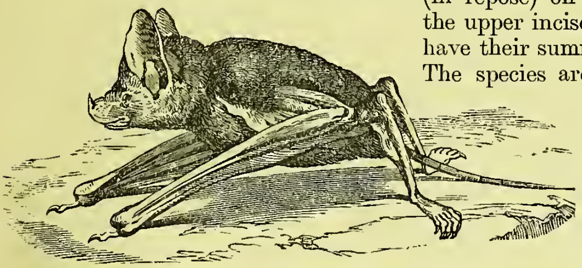
Plecotus auritus, the Long-eared Bat, is also a very common bat in the British Islands. Unlike the Pipistrelle, it rarely flies over water, and resorts generally to old houses, roofs of churches, and such like places. It has a wide distribution in Europe, Northern Africa, and Asia.

Kerivoula picta is a pretty bat, generally distributed on the peninsula of India, and to be met with in Ceylon, Burmah, Java, and Sumatra. The very peculiar marking of orange and black which distinguish this species may be the result of protective mimicry. Mr. Swinhoe remarks:—"A species of Kerivoula, allied to K. picta and K. formosa, was brought to me by a native. The body of this bat was of an orange-brown, but the wings were painted with orange-yellow and black. It was caught, suspended head downwards, on a cluster of the round fruit of the Longan tree (*Nephelium longanum*). Now, this tree is an evergreen; and all the year through some portion of its foliage is undergoing decay, the particular leaves being, in such a stage, partially orange and black. This bat can, therefore, at all seasons suspend itself from the branches, and elude its enemies by its resemblance to the leaf of the tree. It was in August when this specimen was brought to me. It had at that season found the fruit ripe and reddish-yellow, and had tried to escape observation by the semblance of its own tints to those of the fruit."

Miniopterus Schreibersii may be mentioned as a species belonging to the second group of this family. It has a wide geographical distribution, being found from Japan to Australia, Burmah, Ceylon, Syria, Europe, as far north as Switzerland, and is apparently generally distributed throughout the African Continent and Madagascar.

FAMILY XIII.—EMBALLONURIDÆ.

The bats of this family are short-headed; the extremity of the muzzle projects, and the nostrils open in it by simple or valvular apertures, having no foliaceous appendages; the ears are large and often united; and the first phalanx of the middle finger is folded forward (in repose) on the back of the metacarpal bone; the upper incisors are generally a single pair, and have their summits directed inwards and forwards. The species are to be met with in every region. The family has been divided by Dr. Dobson into two sub-families, Emballonurinæ and Molossinæ. Of the genera belonging to the first sub-family we need only quote Emballonura, Taphozous, Rhinopoma, and Noctilio; and of those belonging to the second, Molossus and Mystacina.


THE EGYPTIAN BAT (*Rhinopoma microphyllum*).

Rhinopoma microphyllum shows the valvular nostrils in the anterior margin of a rudimentary nose-leaf, which is of exceptional occurrence in this family. This species has also a long slender tail, produced considerably beyond the interfemoral membrane. It is met with in Africa.

Molossus rufus is not an uncommon bat in Jamaica. In that delightful work, "The Naturalist in Jamaica," Mr. Gosse tells us that, among the inmates of a house at which he was stopping, at Bluefulds, "between the ceiling and the shingles of the roof certain bats found a lodging, emerging at nightfall from a small hole beneath the eaves. Soon after sunset we hear the scrambling of little claws along the plaster, gradually tending towards the point where the hole is situated. At length, just as the stars begin to come out one by one in the sky, one of the boldest peeps forth his sombre face, and plunges down into the air, rising with expanding wings at the distance of a foot or two, and sails away to procure his insect-supper. Another immediately follows the first, and at his heels is another and another, until perhaps half a dozen are out. Then there is a pause for some little time, during which more scrambling is heard, and presently another leader emerges, with a 'tail' of three or four more in Indian file, and so on till about fifteen have come forth—the whole household. I judge that they crawl along one after another in a straight line to the outlet in parties. After having witnessed the exit of the party on one or two evenings, and been assured by my friends that the same performance was nightly repeated, I determined to essay the capture of some specimens to ascertain the species. The hole in the eaves was within reach of the top of the steps, where I stationed myself with an insect net about sunset, to the no small interest of the children. We presently heard one slowly scuffling along upon the plaster, making a smothered chirping sound. This enabled me to trace his progress by the ear, and when he seemed to be near the hole I held up the gauze net in front. The sight of this evidently, however, deterred the bat, for he remained at the mouth chirping, but without attempting a flight. At length I removed the net to the distance of a foot or two, holding it in ready to strike. He now ventured forth, thinking the coast clear, but the projecting eaves compelled him to fly downwards, and I was alert enough to receive him into the bag of the net. It proved to be M. rufus. Several other specimens I obtained in the same way on the same and other evenings, but the residue evidently became increasingly suspicious and loth to leave the hole whilst I was watching. Wishing to examine one alive more carefully, I allowed it to remain in the bag of the gauze net all night, simply giving the net a twist over the rod. In the morning, to my great chagrin, I found the bat almost entirely devoured by rats, which are here very bold and rapacious. I had, however, other opportunities of studying their habits in captivity. When handled, its impatience of confinement is manifested by a continuous screeching, not very loud, but excessively harsh and shrill. A female which I kept for a few days was very sullen. I offered her cockroaches, a noctua, and a long corn beetle, but she would not eat. She would seize and bite them spitefully, but presently dropped them. She would not drink when held in the hand and the muzzle presented to water, but if it were allowed to fall in drops on her face she would suck them in with a motion of chewing with apparent satisfaction. There was much of mastiff manners as well as physiognomy in her; she often bared her teeth by contracting the sides of the lips, and watched with open mouth to seize any object presented, which she then held with surprising force and pertinacity."

FAMILY XIV.—PHYLLOSTOMIDÆ.

This family contains the simple Leaf-nosed Bats. The middle finger has three phalanges; first phalanx of the middle finger short; nostrils either as in the previous family or in the midst of a cutaneous appendage; chin with warts or erect cutaneous ridges. Dr. Dobson makes two sub-families: the Lobostominæ—chin with cutaneous ridges; the Phyllostominæ—chin with warts. In one section of the latter sub-family, true molars are present, and the upper incisors are four. In one group of this section, Vampire, the muzzle is long, the tongue is only moderately long, obtuse, and the lower lip is not cleft. In a second group, the Glossophagæ, the muzzle is long, the tongue is very long, attenuated, and the lower lip is deeply grooved. In a third group, Stenodermata, the muzzle is short, broad, and obtuse. In the second section there are no true molars, and the upper incisors are two, and the fourth group contains the Desmodontes. All the species of this family are confined to the New World, being found from Mexico and the Antilles to Chili. One species is found so far north-west as California. The celebrated Blood-sucking Vampire Bats of South America belong to this group. At least thirty, and perhaps upwards of sixty, species belong to this family.

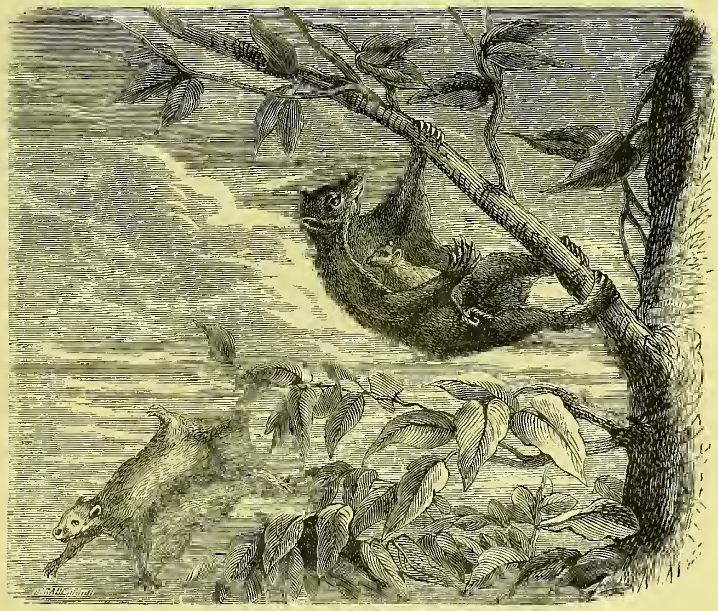
Desmodus rufus is found in South America. It will serve as an illustration of a fourth group. Of an allied species, Mr. Darwin writes:—"The vampire bat is often the cause of much trouble by biting the horses on their withers. The injury is not so much owing to the loss of blood as to the inflammation which the pressure of the saddle afterwards produces. The whole circumstance has lately been doubted in England; I was, therefore, fortunate in being present when one (*D. D'Orbignyi*) was actually caught on a horse's back. We were bivouacking, late one evening, near Coquimbo, in Chili, when my servant, noticing that one of the horses was very restive, went to see what was the matter, and, fancying he could distinguish something, suddenly put his hand on the beast's withers, and secured the vampire. In the morning the spot where the bite had been inflicted was easily distinguished by its being slightly swollen and bloody. The third day afterwards we rode the horse without any ill effects."

Stenoderma perspicillatum, from the Brazils, will serve as an illustration of the third group. Glossophaga amplexicauda, from South America, belongs to the second group; while Vampyrus spectrum will give some idea of the bats of the first group.

The species belonging to the section Lobostominæ, with cutaneous ridges on the chin, are placed in the genera Chilonycteris, Pteronotus, and Mormops; they are chiefly found in the West India Islands.

ORDER III.—INSECT-EATING ANIMALS (*Insectivora*).

The animals belonging to this order are almost all small, and they remind one very often by their shape of the animals belonging to the order of Rodents—that order to which the rats and mice belong. Many of the Insectivores live under the ground. All of them possess a collar bone. In some of them the number of ribs is very large, and these enclose part of the abdomen as well as the thorax. In some, in addition to the fur, long bristles are met with, and in some scales seem to take the place of hair. The feet are plantigrade, that is, the whole sole is, in walking, placed on the ground: they are often pentadactylous. The order receives its name from the peculiar structure of the teeth, which are, in all instances, furnished with elevated and pointed tubercles for the purpose of breaking to pieces the hard insects on which most of them live. While they possess all three sorts of teeth, yet in many true canines are wanting, and the molar teeth are often smaller than the incisors; these latter are very various in number, and the number is almost always different in the two jaws. It will also be found that besides insects, they feed on fruit and even fish. Like the lemurs and bats, they are for the most part nocturnal, and such of them as inhabit cold countries pass the winter months in a state of torpidity. Mivart, nearly following Peters, enumerates nine families belonging to this order, the first of which, and the most anomalous, is that called



THE COLUGO (*Galeopithecus volans*).

FAMILY XV.—THE COLUGOS (*Galeopithecidæ*).

This family contains but a single genus, Galeopithecus, with two species. These have generally been placed among the Lemurs, but it seems preferable to consider them as coming at the head of the Insectivora. The feet are pentadactylous, with the fore toes not elongate, and all of them clawed. The body is surrounded by a membrane, over which the fur extends. This membrane stretches from the nape of the neck to the hands, and is then continued along the flanks of the body to the soles of the feet, behind which it is produced, forming a triangular flap, of which the tail forms the apex. Only two species are known: Galeopithecus volans is found in Borneo, Sumatra, and Malacca. Wallace describes it as sluggish in its motions, at least by day, going up a tree by short runs of a few feet, and then stopping a moment, as if the action were difficult. In flying it passes obliquely through the air. It rests clinging to the trunks of trees, where its olive or brown fur, mottled with irregular whitish spots and blotches, resembles closely the colour of mottled bark, and no doubt helps to protect it. "Once in a bright twilight," Mr. Wallace says, "one of these animals ran up a trunk in a rather open place, and then glided obliquely through the air to another tree, on which it alighted near its base, and immediately began to ascend. The distance was found to be two hundred and ten feet, and the amount of descent less than one in five, thus proving that it had some power of guiding itself through the air, otherwise, in so long a distance, it would have had little chance of alighting exactly upon the trunk. It feeds chiefly on leaves. Its brain is small, and it possesses such remarkable tenacity of life that it is exceedingly hard to kill. The tail is prehensile, and is probably made use of as an additional support while feeding. It is said to have only a single young one at a time, and my own observations confirm this statement, for I once shot a female, with a very small blind and naked little one clinging to its breast. The little one was quite bare and wrinkled, reminding me of the young of Marsupials, to which it seemed to form a transition. The fur of these animals is short, but exquisitely soft, resembling in its texture that of the chinchilla." Mr. Wallace elsewhere remarks that this animal seems to be a lateral offshoot of some low form, which has survived during the development of the Insectivores—the Lemuroidea and the Marsupials.

THE AFRICAN ELEPHANT SHREW (*Macroscelides Rozeti*).

The second species, C. Philippinensis, is found in the Philippine Islands.

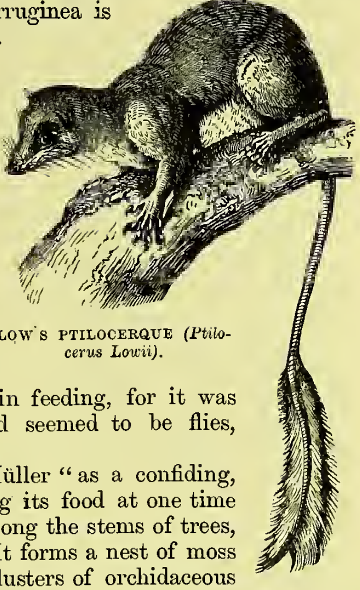
FAMILY XVI.—THE ELEPHANT SHREWS (*Macroscelididæ*).

This family contains less than a dozen species, placed in three genera, and are generally known as the Elephant Shrews. The nose is extended into a long slender proboscis, with the nostrils at the very end, but opening out a little obliquely. Their eyes are sometimes large, and the ears are of good size. The fore feet are pentadactylous, and the thumb and little finger are short; the hind feet are very much longer, and the four toes are equal in size, while the thumb is short or absent. There are three genera: the first, Macroscelides, contains some seven or eight species; these are almost confined to South Africa, creeping up the east coast as far as the Zambesi and Mozambique. One species, M. Rozeti, inhabits Barbary and Algeria, not being very uncommon about Oran. They are inoffensive little creatures. Though chiefly feeding on insects, they also eat vegetable food. The second genus, Petrodromus, contains but a single species, P. tetradactylus. It has but four toes on its hind feet, though it has five fingers on its fore feet. It is found at Mozambique, and was described by Prof. Peters. The third genus, Rhynchyon, also contains but one species from the same locality, R. cirnei (Peters), and it has only four toes and four fingers.

THE FERRUGINOUS BANGSRING (*Tupaia ferruginea*).

FAMILY XVII.—THE BANGSRINGS (*Tupaiidæ*).

This is another small family, with the same number of genera and about the same number of species as the last. The animals belonging to it are squirrel-like shrews, living in trees, which they climb with immense agility. Their tails are long and bushy. They feed on insects and fruit. Of the genera, the first, Tupaia, contains seven species, and these are mostly found in the Malay Islands, though a few species are found in Northern and Continental India; Tupaia ferruginea is found in Java, Sumatra, Borneo, Penang, and Singapore.

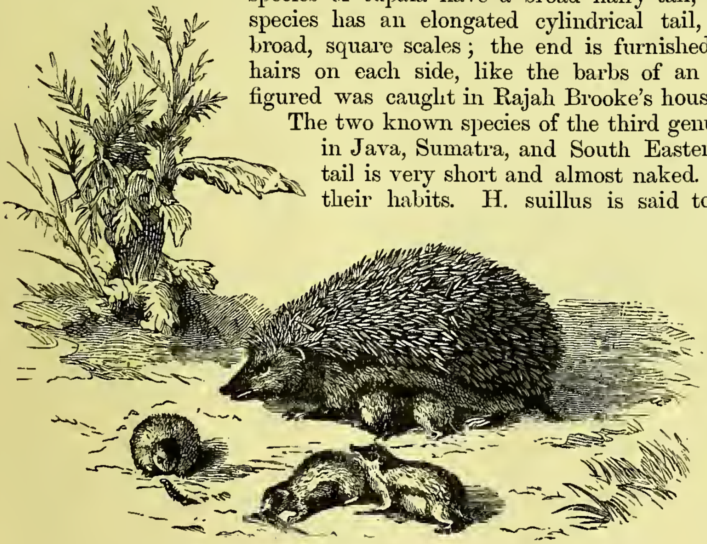

LOW'S PTILOCERQUE (*Ptilocerus Lowii*).

Sir T. S. Raffles states that a tame tupaia of this species, which was suffered to go about at perfect liberty, ranged in freedom over the whole house, and never failed to present himself on the breakfast and dinner table, where he partook of fruit and milk. In the "Proceedings of the Asiatic Society," it is stated that another was brought to Bengal by a medical gentleman; it ran about the house tame, but would not allow itself to be caught for close inspection. Though at liberty to run out of doors whenever it liked, it had no disposition to leave its quarters, and evinced some attachment to the family. Whenever strangers entered the house it showed disquietude, and made a chattering noise. It gave no trouble in feeding, for it was always in search after insects; and its favourite food seemed to be flies, crickets, grasshoppers, and cockroaches.

Another species, T. javanica, is described by Dr. Müller "as a confiding, simple, and lively little animal, always in motion, seeking its food at one time on the ground, among moss and dry leaves, at another along the stems of trees, dipping its nose rapidly into the fissures and hollows. It forms a nest of moss at some distance above the ground, supporting it on clusters of orchidaceous plants which are attached to the forest trees." They smooth their head and face with both fore paws.

Ptilocerus Lowii is the only representative of the second genus. This elegant little animal was described by Dr. J. E. Gray, from a specimen sent from Borneo. While the species of tupaia have a broad hairy tail, like the squirrels, this species has an elongated cylindrical tail, covered with rows of broad, square scales; the end is furnished with a series of stiff hairs on each side, like the barbs of an arrow. The specimen figured was caught in Rajah Brooke's house, at Sarawak.

The two known species of the third genus, Hylomys, are found in Java, Sumatra, and South Eastern Asia. In them the tail is very short and almost naked. Little is known as to their habits. H. suillus is said to have been taken in Java, at a height of 1,200 to 2,000 feet.


THE HEDGEHOG (*Erinaceus Europæus*).

FAMILY XVIII.—THE HEDGEHOGS.
(*Erinacidæ*).

This is the first family of Insectivora which contains in it European forms, of which the Common Hedgehog will be the most familiar example. There are but two genera, Erinaceus and Gymnura. The snout is produced, ears are moderate, eyes small, feet pentadactylous; tail short in Erinaceus, long in Gymnura; body covered with spines, bristles, and hair.

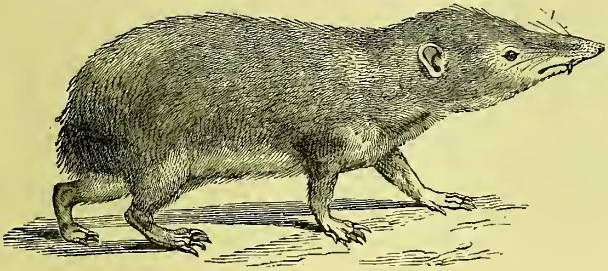
Of the genus Erinaceus, there are fourteen or fifteen species; these are found in Europe, Asia, and Africa, but are not met with in Australia or the New World. The best-known species is the Common Hedgehog (*E. Europæus*). The hedgehog, when full grown, is about nine inches and a half in length. Its upper part is covered with sharp spines. The body is thick, the crown of the head high, the muzzle acute, the ears of a medium size and somewhat rounded, the toes have strong nails, the tail is very short. It is very frequently found in Great Britain and Ireland—indeed, as its name imports, it is found through almost all Europe, except Norway and Lapland—and resides in small thickets, on the borders of woods and copses, in hedges, and in dry ditches.

This animal, as is well known, has the power of rolling itself up into a ball, which it does by means of a peculiar muscular expansion beneath the skin, which enables it to inclose itself in its panoply as in a mantle and hood, the margin of which is closed by means of a circular muscle, the head and limbs being retracted within. While the animal is thus enveloped, the spines are stiffly set. Mr. Bell states that he has seen, and that repeatedly, a domesticated hedgehog in his possession run towards the precipitous wall of an area, and, without a moment's pause for preparation, throw itself off, contracting at the same instant into a ball, in which condition it reached the ground from a height of twelve or fourteen feet. So safely did it fall, that after only a few moments it unfolded itself, and did not creep but ran away. The female breeds early in the summer, having formed a nest with much skill, roofed so as to throw off the rain, while within it is well lined with leaves and moss. The young, from two to four in number, are blind at their birth, are about two inches long, and are perfectly white and naked, though the rudiments of the spines may be perceived.

Hedgehogs live in pairs, and are nocturnal in their habits. The creature frequents woods, copses, old gardens, orchards, and thick hedgerows, where it remains rolled up in its retreat during the day, but coming forth on the approach of twilight, and continuing till morning on the alert. Its food consists of insects, eggs, young worms, snails, slugs, frogs, nestlings, and various kinds of roots, also ripe fruits which fall from the trees in the orchard. The hedgehog may be easily domesticated, and even becomes familiar, feeding on soaked bread, vegetables, and meat. The Calmuck Tartars keep it in their huts instead of cats, for the purpose of driving away vermin. It passes the winter in a state of complete torpidity. To do so, it secures a retreat in banks, under the hollow roots of trees, in holes, and other sheltered and convenient places. Here it constructs a sort of nest or bed of grasses, dried leaves, and moss, with which it covers itself thickly and closely. When discovered in these circumstances, it resembles a ball of herbage, which it seems to have attached to its spines by repeatedly rolling round amidst a quantity of materials of this kind, which it had previously collected.

E. auritus inhabits the province of Astracan, between the Volga and Ural rivers, as well as Tartary beyond Lake Baikal. A very delicate fur, consisting of long silky hairs of a white colour, covers the head, breast, and abdomen of this species, forming also along the sides and buttocks a beautiful ornamental border.

E. collaris is met with generally in India. Captain Hutton says of the Indian species of hedgehog:—" The habits of all three species are alike; they are nocturnal, and during the day conceal themselves in holes, or in the tufts of high jungle grass. Their food consists of insects—chiefly of a small beetle which is abundant on the sandy tracts of Bhawulpoor, and belongs to the genus Blaps. They also feed on lizards and snails. When touched, they have the habit of suddenly jerking up the back with some force, so as to prick the fingers or mouth of the assailant, and at the same time emitting a blowing sound, not unlike the noise produced when blowing upon a flame with a pair of bellows. When alarmed, they have the power of rolling themselves up into a complete ball, concealing the head and limbs, as does the European hedgehog." Respecting E. collaris, he observes:—" On hearing any noise, it jerks the skin and quills of the neck completely over its head, leaving only the tip of the nose free, which is turned quickly in every direction, to ascertain the nature of the approaching danger. If a foe in reality come nigh it, the head is doubled under the belly towards the tail, and, the legs being withdrawn at the same time, it presents nothing but a prickly ball to its assailant, and which is, in most cases, a sufficient protection. In this state it remains for some time perfectly motionless, until all being quiet, and the danger past, it ventures, first slowly and almost imperceptibly, to extend the nose, the nostrils working quickly, as if to ascertain that all is safe again. It then gradually uncoils until the eyes are left free, and if satisfied that its foe has passed on, it opens up, and walks off with a quick but unsteady gait; or if again startled by the slightest noise near it, it is instantly intrenched within its thorny armour. All the species use the snout much in the same manner as the hog does, turning up the leaves and grasses in search of food, and shoving each other out of the way with it when angry. They make a grunting sort of noise when irritated. They are remarkably tenacious of life, bearing long abstinence with apparent ease—a provision of nature highly useful and essential in the desert tracts they inhabit. It is probable, too, that they remain during the cold season in a semi-torpid state, as the species which occurs in Afghanistan hybernates."



THE TANREC (*Centetes ecaudatus*).

The curious species belonging to the second genus Gymnura, which is called after Sir T. S. Raffles, G. rafflesii, is found in Borneo, Sumatra, and the Malay Peninsula. Its dentition differs from that of the hedgehogs. While the feet are pentadactylous, the three middle toes are longer than the others, the ears are rounded and naked; long bristles, especially on the back, are scattered among the hair; the tail is long, but sparsely haired, and is scaly.

FAMILY XIX.—THE TANRECS (*Centetidæ*).

This family contains two rather distinct groups—that containing the Tanrecs, or Agouta, or Madagascar hedgehogs, and that containing two species of the remarkable genus Solenodon, found in the West Indies; but following Professors Peters and Mivart, we place them together. Of the Madagascar hedgehogs there are now five genera known. Most of them are tailless; all of them are more or less covered with spines. They have not the power of rolling themselves into a ball. The absence of clavicles (collar bones), and the fact that the tibia and fibula are anchylosed together below, are very noteworthy anatomical peculiarities that distinguish this family.

The Tanrec (*Centetes ecaudatus*) is about the size of the European hedgehog. It feeds on worms and insects, and for about three months during the hottest part of the year it retires under ground. It has become quite naturalised at the Mauritius.

The Spiny Tanrec (*Ericulus spinosus*) is considerably smaller than the previously-mentioned species. It is found also in Madagascar.

The remaining genera belonging to this section are the Hemicentetes, Echinops, Oryzorictes, and Geogale; the last a genus described by A. Milne-Edwards for G. hova, and thought to connect the Tanrecs with the next family.

THE AGOUTI (*Solenodon paradoxus*).

But two species of Solenodon are known, and one of these is found in Cuba, and the other in Hayti. The geographical distribution of this family is thus somewhat strange, the Tanrecs being only found to the East of Africa on Madagascar, and these Solenodons on two islands to the East of America.

S. paradoxus, from Hayti, is the longest known species of this genus. The muzzle is elongated; the snout smooth, produced, and with nostrils at the sides of its apex; the eyes are minute; the ears large, round, and nearly naked; the body is hairy; the feet are ambulatory, plantigrade, five-toed, and furnished with claws; the tail is long, smooth, and for the most part scaly.

In size, this animal exceeds a rat; the fur is coarse and long, and of a yellowish-red colour. From the lips and cheeks proceed slender whiskers of great length. The limbs are stout. The two middle incisors of the upper jaw are remarkable for their size and the distance between them and the succeeding incisors; they are compressed, pointed, and perpendicular. Brandt remarks that nothing is known of the mode of life of this animal; but, from the structure of the proboscis and claws, he concludes that it must burrow. The form of the nose he considers indicative of a well-developed organ of smelling. Mr. Hearne, writing from Hayti, June, 1835, says:—"The only quadruped, I believe, found on the island on the landing of Columbus was the *Agouta*—for so it is called by the natives—a little larger than a rat, with an equally long tail and a longer snout, whose food is chiefly grain, although the animal is carnivorous also. Its hair is red. I had one alive, intended for the Zoological Society, but it received a wound from a cat, of which it died."

S. cubanus has been recently described by Professor Peters from Cuba.

FAMILY XX.—THE WEST AFRICAN RIVER SHREWS (*Potamogalidæ*).

We follow Professor Allman in keeping this family for a single species of the genus Potamogale, founded for a curious small otter animal, first found by M. Du Chaillu at the Gaboon, then by Mr. Hewan at Old Calabar, and by the Portuguese at Angola. This remarkable animal is described by Professor Allman as somewhat larger than a stoat, with much the aspect of a small otter; but one is at once struck by the broad, almost spoon-shaped, muzzle, and its very large laterally compressed tail. The muzzle projects about half an inch beyond the extremity of the lower jaw. Each nostril opens beneath the external edge of a cartilaginous valve. The ears are rounded, and the upper fourth is quite naked. The eyes are very small. "This animal," according to M. Du Chaillu, "is found in the mountains of the interior (Gaboon district), or in the hilly country explored by me south and north of the equator. It is found along the water-courses of limpid and clear streams, where fish are abundant. It hides under rocks along these streams, lying in wait for fish. It swims through the water with a rapidity which astonished me. Before a fish has time to move it is caught. It returns to land with its prey previous to eating it."

FAMILY XXI.—THE GOLDEN MOLES (*Chrysochloridæ*).

This family contains the Golden Moles, found chiefly at the Cape of Good Hope. One species extends to the Mozambique. These are small mole-like animals, having a long rigid fur, with green and purple reflections, and of many golden tints. The eyes are covered by the skin. The muzzle is rather elongated; the nose is naked and flesh-coloured; fore feet with four toes, fourth toe very small, but the claw of the third toe is strong, broad, and falciform; hind feet with five toes; no tail. Their dentition is quite different from that of the true moles. They have both incisor, canine, and molar teeth. Professor Mivart makes two genera—Chrysochloris with the molar teeth 3–3, and the lower molars without any posterior process, and Chalcochloris with the molar teeth 2–2, and a marked posterior process on the lower molars.

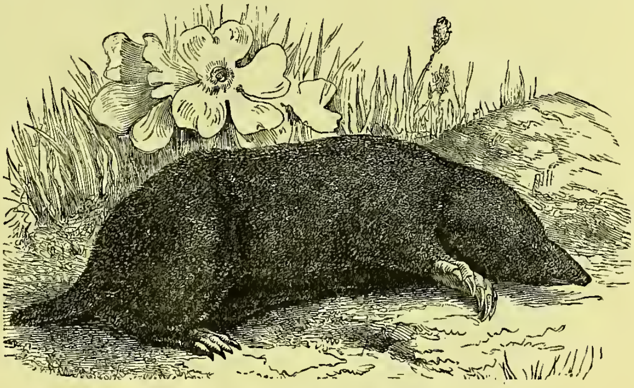
FAMILY XXII.—THE MOLES (*Talpidæ*).

The family of the Moles contains a large number of extraordinary forms, to be met with in Europe, Asia (to Thibet and Japan), and in North America. The body is hairy; feet short, pentadactylous; ears none; tail moderate. There are two sub-families—the first that of the Moles, Talpina; the second, that of the Desmans, Myogalina.

The first is characterised by having the pterygoid region inflated, by the feet being fossorial (with large claws formed for digging), the collar bones being very short and broad, there being no metacromion process, and there being a sickle-shaped carpal bone. This section contains the common mole (*Talpa Europæa*). It is to be met with in Great Britain, but is absent from Ireland and throughout the more northern portion of Europe; it is replaced by T. cœca in the South of Europe.

The wide hand, as the fore limb might be called, which is the great instrument of action, and performs the offices of a pickaxe and shovel, is sharp-edged on its lower margin, and, when clothed with the integuments, the fingers are hardly distinguishable; but the terminating claws, which project, are long, strong, flat, and trenchant. While the fore paws are turned upwards and backwards, for scooping the soil, the feet are employed to throw it out with great quickness behind the animal. These mining operations are aided by the motions of the head, which is lifted with great power, so as to loosen the ground above and overcome the resistance that may be opposed to the progress of the animal.

The organ of sight is almost rudimentary. The little eye is so hidden in the fur, that its very existence was for a long time denied. It appears to be designed for acting only as a warning to the animal on coming into the light; and, indeed, more acute vision would not have been of much value. Though there is no external ear—which would be an impediment in the act of burrowing—the auditory sense is very highly developed, and the tympanum very large. The meatus, or channel of hearing, in this animal, which lives habitually in the soil, is defended by the smallness of the external opening. John Hunter observes that an external *concha* is not to be found in many animals whose life is principally led under ground, such as the mole and, perhaps, because the earth assists considerably in vibration. The muzzle of the mole is evidently a delicate organ of touch, and that sense is considerably developed in the large and broad hands and feet. The gustatory and olfactory nerves (especially the latter) appear to be very sensitive. "The skin," says Pennant, "is most excessively compact, and so tough as not to be cut but with a very sharp knife; the hair is very close set, and softer than the finest silk; the usual colour is black, but there are instances of these creatures being spotted, and a cream-coloured head is sometimes found in my lands near Downing." To the soft, short cut, velvety coat of the mole, no particle of the soil ever adheres. The length of the head and body is about four inches. It lives under ground, and the principal point of its domain, the fortress, is constructed under a considerable hillock, raised in some secure place, often at the root of a tree, under a bank, or any spot offering protection. The fortress has a dome of earth, which has been beaten and compressed by the architects into a compact and solid state. Species of this genus are spread over Europe and Asia to Japan.



THE MOLE (*Talpa Europæa*).

The Star-nosed Mole (*Condylura cristata*) inhabits eastern North America.

Scaptochirus moschatus is described by A. Milne-Edwards from North China. It comes near Talpa, but has a different dentition. Scapanus townsendi and S. breweri extend from New York to San Francisco. Scalops aquaticus, the Shrew Mole, ranges along the Atlantic States, from lat. 42° to 27·30 N.

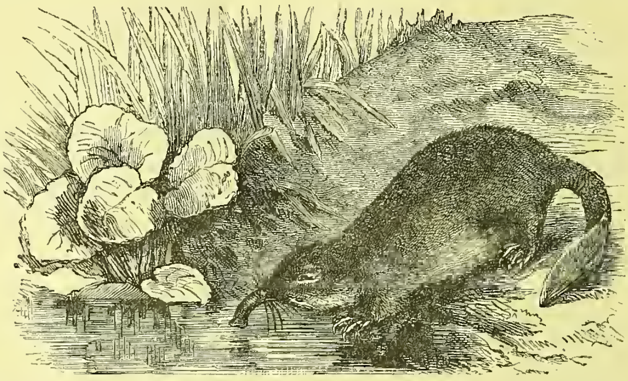
The Desmans belong to the second sub-family—that of Myogalina. The pterygoid region is not inflated. The collar bones and shoulder bones are elongated. The feet are not formed for digging, and there is no sickle-shaped carpal bone. Of the genus Myogale there are but two species. One, the Muscovite Desman (*M. muscovitica*), is found in Southern Russia, where it is common in the Volga and the Don. It is about eight inches in length, and swims with great rapidity, remaining long under water, with only the end of its snout, where its nostrils are placed, over the water. It burrows in the banks of streams and pools, feeds on both worms and insects, and is said to eat leeches, and sometimes the root of water lilies.

M. pyrenaica is found just at the other end of Europe, being not uncommon along streams in the valleys of the French Pyrenees and near Tarbes. It differs from the former in the tail being longer than the body, covered with short hairs, and, although only half its size, the claws are much longer.

Nectogale elegans is the name given by A. Milne-Edwards to a small animal from Thibet, which seems in some measure a transition form between the Desman and the next family—that of the shrews; while in its dentition it resembles the shrews, yet in its feet and tail it somewhat resembles Myogale.

Urotrichus talpoides is a shrew-like mole, said to be very common in Japan. The claws are small and slender; the tail short, but furnished with long hairs. U. Gibbsii is another species from the Cascade Mountains, British Columbia.

Uropsilus soricipes (A. Milne-Edwards) is described as intermediate between the last genus and the next family. It was found at Moupin, Thibet.


THE DESMAN *(Myogale Muscovitica).*

Anurosorex squamipes (A. Milne-Edwards), with scaly feet and an extremely short tail, is described from Thibet; and Scaptonyx fusicaudatus (A. Milne-Edwards) is described as intermediate between Talpa and Urotrichus from Western China.

All these new forms show how unsettled we must regard the classification of these interesting forms, even after the labours of Peters, Mivart, and A. Milne-Edwards.

FAMILY XXIII.—THE SHREWS (*Soricidæ*).

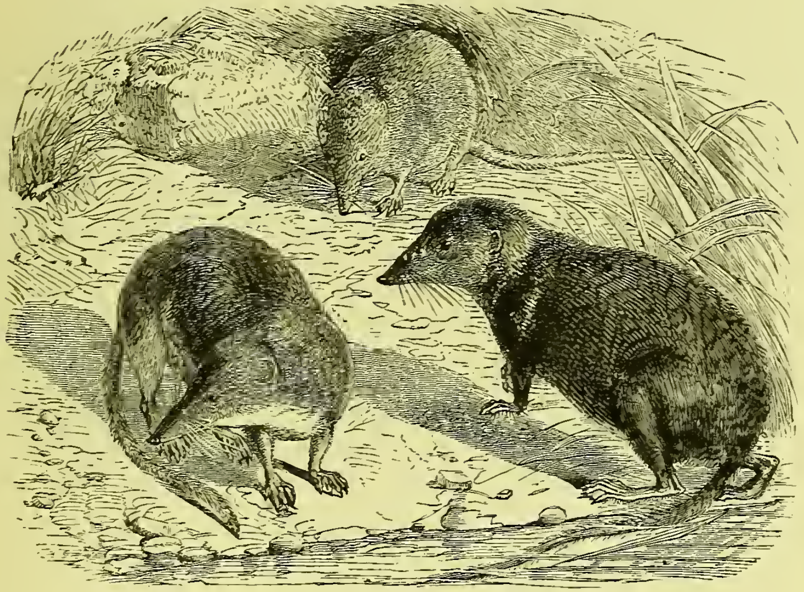
This, the last family of the Insectivora, contains the Shrews. They have a wide distribution, being found throughout the globe, except in Australia; and, although more than sixty-six species are now known, doubtless many remain as yet undescribed, which is not to be wondered at when the size of the species is remembered. Indeed, one of the species —Sorex (C.) etrusca—is supposed to be the very smallest living mammal. The species are most numerous in the warm tropical regions; next to this in North America; while they are least so in Europe. The head is produced, and the nose is more or less mobile. The eyes are small; the ears broad; feet pentadactylous, cloven; the tail moderate. They live in subterranean holes, and in general form resemble mice. There is no pterygoid fossa and no zygoma, and while the manubrium is broad, it is not keeled. There is a series of odoriferous glands on each side of the body, between the fore and hind legs. In many the ears can be folded together when they are under the water. According to Owen, they change their milk teeth before birth. The typical genus is Sorex. Some zoologists make eleven, some five, sub-genera. We have not space to enumerate all.

Sorex vulgaris is our Common Shrew. It is the most common species in England. It is found throughout Europe. The colour of the Shrew Mouse is, in general, a reddish-brown, but some are of an ash-colour; many are white under the stomach, and others of a pale brownish-grey. It usually resides in barns, stables, hay-lofts, and on dung-hills; sometimes it is found in woods and fields beneath the roots of trees, or under heaps of fagots or leaves, where it forms a nest, which is framed of soft grasses and other plants. It is generally found in a hole, more or less shallow, in the ground, or a dry bank, accessible at the side—being, so to speak, roofed over. Here the female produces, in the spring, from five to seven little ones.

It feeds on insects, grain, and roots. When chased or ensnared, it utters a cry more sharp and piercing than that of the mouse. It has a strong offensive smell, owing to which most cats reject its flesh, or, if they eat any part of it, they are afterwards subject to sickness. They will, however, pursue and kill it whenever they have an opportunity.

Notwithstanding its stealthy kind of life, it is not secure from the attacks of enemies, as it is frequently seized by the kestrel and owls of different kinds, especially the barn-owl.

The Water Shrew (*Crossopus fodiens*) is somewhat larger than the common shrew. It is of a blackish-brown above, of a silvery white beneath, and the colours are abruptly defined. Its length, including the tail, is nearly five inches and a half, its form being similar to that of the common shrew, but more elongated; and its tail about two-thirds of the length of that of the head and body together, or rather longer than the latter. The snout is considerably flattened; the ears very short and rounded, with three lobes internally, one of which is margined with white hairs, forming a speck of that colour among the dusky fur; the tail slender, somewhat quadrangular, a little compressed at the end, and fringed beneath with bristly white hairs. The feet are proportionably broader than those of the common shrew, and the toes are laterally margined with white shining bristly hairs. The fur is soft, and of a velvety or silky texture.



COMMON OARED AND WATER SHREWS.

This species, which has been observed in different parts of England and Scotland, resides in burrows, on the margins of ponds, brooks, and ditches, and appears to be quite aquatic in its habits. It feeds on insects, worms, tadpoles, and small fish, in seeking for which it makes excursions on the water, and dives with ease to the bottom. In swimming it presents a singular appearance, its sides being apparently expanded, its body lying so lightly as to be two-thirds out of the water, while its tail is extended along the surface, and thus it paddles away, seemingly with little effort, scarcely causing a ripple.

These little water shrews form colonies in certain spots, making runs or tracks along the banks, leading from their subterranean dwellings to the water.

The House Shrew Mouse (*Crocidura aranea*), while it inhabits the greater part of Europe, has not as yet been met with in Great Britain. The traveller in Switzerland is sure to meet with it. In summer it frequents gardens and the neighbourhood of houses. In autumn it comes into the outhouses, where, says Dr. Fatio, it lets its presence be felt by "its thefts and bloody murders." It kills and eats every small cage bird that it can come at. It often shows itself by day, though night is its time of activity.

C. etrusca is thought to be the smallest of all mammals. It is about one inch and a half long, with a tail of about one inch in length.

Blarina talpoides is the Mole Shrew of North America, where the species of this subgenus are found, stretching down as far south as Florida and Mexico.

Neosorex navigator is the Water Shrew of Vancouver's Land.

ORDER IV.—FLESH-EATING ANIMALS (*Carnivora*).

This large order contains a number of well-known species, which for the most part agree in having incisor, canine, and molar teeth conical, the latter equably enamelled, and either tuberculate or cuspidate; feet clawed, the claws acute curved, thumb not separable from the other toes. They live for the most part on animal food: whence their name; a few, however, eat also vegetables and fruits. Their motions are generally rapid, and they have extraordinary muscular power. Their organs of sight and smell are wonderfully developed. The fore and hind limbs are used for walking, climbing, and swimming. This order is divided into two sub-orders: 1. That of the Fissipedia; 2. That of the Pinnipedia.

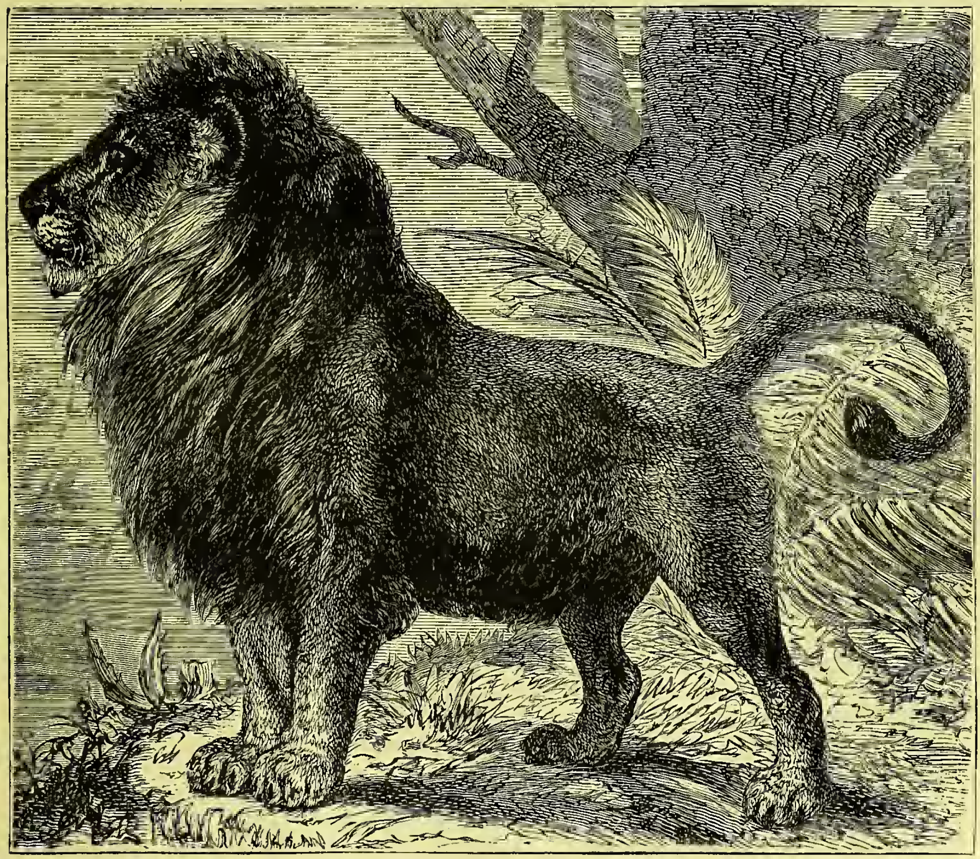
SUB-ORDER 1.—FISSIPEDIA.

To this section belong the species which especially deserve the name carnivora, or beasts of prey. Although some can, as the otter, swim, yet all have feet capable of running. The cutting teeth are six in each jaw, regular; the canine teeth, one on each side of the jaws, are conical; they have both premolars and true molars, the former successional, the latter not. Of this sub-order there are ten families, which contain the lions, cats, hyæna, dogs, weasels, and bears. Some of them run, like the cat or dog, on the tips of their fingers, or digits, and are hence called digitigrades; others plant the whole hand and foot on the ground in progressing, and are called plantigrades, as the bears.

FAMILY XXIV.—FELIDÆ.

In this family the head is short and rounded. The legs vary in the three genera: being of moderate size and nearly equal in Felis; being elongate, and the hinder the longest, in Lyncus; and being very long, slender, and unequal in Cynælurus. The flesh tooth in the first two genera has a well-marked prominent internal lobe on the front part of its inner side, which is absent in the third genus. Some naturalists, as Dr. J. E. Gray, divide the genus Felis, which contains upwards of fifty-seven species, into eleven sub-genera; but for present purposes we shall overlook these. Of the species we can but mention a few of the more remarkable, commencing with the noblest of the cats.

The Lion (*F. leo*) is found over Africa and South-western Asia. In the time of Xerxes (if Herodotus makes no mistake) the lion was still existing in Greece, and attacked the camels of his army; now Europe only possesses the remains of lions found in diluvial caverns. Formerly numerous in the Holy Land, they are now but rarely to be met with. The male lion has the head, neck, sides of the body, and legs maned. The tail is elongate and tufted. The colour is generally a deep chestnut brown, but it is sometimes a pale or tawny brown. Stories innumerable are told about this king of the beasts. The great African traveller, Dr. Livingstone, tells us "that when a lion is met in the day-time, a circumstance by no means unfrequent to travellers in certain parts of South Africa, if pre-conceived notions do not lead them to expect something very 'noble,' or 'majestic,' they will see merely an animal somewhat larger than the biggest dog they ever saw, and partaking very strongly of the canine features; the face is not much like the usual drawings of a lion, the nose being prolonged, like a dog's; not exactly such as our painters make it, though they might learn better at the Zoological Gardens: their ideas of majesty being usually shown by making their lions' faces like old women in nightcaps. When encountered in the day-time, the lion stands a second or two gazing, then turns slowly round, and walks as slowly away for a dozen paces, looking over his shoulder, then begins to trot, and, when he thinks himself out of sight, bounds off like a greyhound. By day there is not, as a rule, the smallest danger of lions which are not molested attacking man, nor even on a clear moonlight night, except when they possess young ones. This makes them brave almost any danger; and if a man happens to cross windward of them, both lion and lioness will rush at him, in the manner of a bitch with whelps. This does not often happen, as I only became aware of two or three instances of it. In one case a man, passing where the wind blew from him to the animals, was bitten before he could climb a tree; and occasionally a man on horseback has been caught by the leg under the same circumstances. So general, however, is the sense of security on moonlight nights, that we seldom tied up our oxen, but let them lie loose by the wagons; while on a dark rainy night, if a lion is in the neighbourhood, he is almost sure to venture to kill an ox. His approach is always stealthy, except when wounded; and any appearance of a trap is enough to cause him to refrain from making the last spring. This seems characteristic of the feline species. When a goat is picketed in India for the purpose of enabling the huntsman to shoot a tiger by night, if on a plain, he would whip off the animal so quickly by a stroke of the paw that no one could take aim. To obviate this, a small pit is dug, and the goat is picketed to a stake in the bottom; a small stone is tied in the ear of the goat, which makes him cry the whole night. When the tiger sees the appearance of a trap, he walks round and round the pit, and allows the hunter, who is lying in wait, to have a fair shot. When a lion is very hungry, and lying in wait, the sight of an animal may make him commence stalking it. In one case a man, while stealthily crawling towards a rhinoceros, happened to glance behind him, and found, to his horror, a lion stalking him; he only escaped by springing up a tree like a cat. At Lopepe, a lioness sprang on the after quarter of Mr. Oswell's horse, and when we came up to him we found the marks of the claws on the horse, and a scratch on Mr. Oswell's hand. The horse on feeling the lion on him sprang away, and the rider, caught by a wait-a-bit thorn, was brought to the ground and rendered insensible. His dogs saved him. Another English gentleman (Captain Codrington) was surprised in the same way, though not hunting the lion at the time, but turning round he shot him dead in the neck. By accident, a horse belonging to Codrington ran away, but was stopped by the bridle catching



THE LION (*Felis leo*).

a stump. There he remained a prisoner two days, and when found the whole space around was marked by the footprints of lions. They had evidently been afraid to attack the haltered horse from fear that it was a trap. Two lions came up by night to within three yards of oxen tied to a wagon, and a sheep tied to a tree, and stood roaring, but afraid to make a spring. On another occasion, one of our party was lying sound asleep and unconscious of danger between two natives behind a bush at Mashue. The fire was nearly out at their feet, in consequence of all being completely tired out by the fatigues of the previous day. A lion came up to within three yards of the fire, and there commenced roaring, instead of making a spring; the fact of their riding ox being tied to the bush was the only reason the lion had for not following his instinct, and making a meal of flesh. He then stood on a knoll three hundred yards distant, and roared all night, and continued his growling as the party moved off by daylight next morning. Nothing that I ever learned of the lion would lead me to attribute to it either the ferocious or noble character ascribed to it elsewhere. It possesses none of the nobility of the Newfoundland or St. Bernard dogs. With respect to its great strength there can be no doubt. The immense masses of muscle around its jaws, shoulders, and fore-arms proclaim tremendous force. They would seem, however, to be inferior in power to those of the Indian tiger. Most of those feats of strength that I have seen performed by lions, such as the taking away of an ox, were not carrying, but dragging or trailing the carcase along the ground; they have sprung, on some occasions, on to the hind-quarters of a horse, but no one has ever seen them on the withers of a giraffe. They do not mount on the hind-quarters of an eland even, but try to tear him down with their claws. In general the lion seizes the animal he is attacking by the flank, near the hind leg, or by the throat, below the jaw. It is questionable whether he ever attempts to seize an animal by the withers. The flank is the most common point of attack, and that is the part he begins to feast on first. When gorged, the lion falls fast asleep, and is then easily despatched. Hunting a lion with dogs involves very little danger as compared with hunting the Indian tiger, because the dogs bring him out of cover and make him stand at bay, giving the hunter plenty of time for a good deliberate shot. Where game is abundant, there you may expect lions in proportionately large numbers. They are never seen in herds; but six or eight, probably one family, occasionally hunt together. One is in much more danger of being run over when walking in the streets of London than he is of being devoured by lions in Africa, unless engaged in hunting the animal. Indeed, nothing that I have seen or heard about lions, would constitute a barrier in the way of men of ordinary courage and enterprise. The same feeling which has induced the modern painter to caricature the lion has led the sentimentalist to consider the lion's roar the most terrific of all earthly sounds. We hear of the "majestic roar of the king of beasts." It is, indeed, well calculated to inspire fear if you hear it in combination with the tremendously loud thunder of that country, on a night so pitchy dark that every flash of the intensely vivid lightning leaves you with the impression of stone-blindness, while the rain pours down so fast that your fire goes out, leaving you without the protection of even a tree, or the chance of your gun going off. But when you are in a comfortable house or wagon, the case is very different, and you hear the roar of the lion without any awe or alarm. The silly ostrich makes a noise as loud, yet he never was feared by man. To talk of the majestic roar of the lion is mere majestic twaddle. On my mentioning this fact some years ago, the assertion was doubted, so I have been careful ever since to inquire the opinions of Europeans, who have heard both, if they could detect any difference between the roar of a lion and that of an ostrich. The invariable answer was that they could not when the animal was at any distance. The natives assert that they can detect a variation between the commencement of the noise of each. There is, it must be admitted, considerable difference between the singing noise of a lion when full, and his deep gruff growl when hungry. In general, the lion's voice seems to come deeper from the chest than that of the ostrich; but to this day I can distinguish between them with certainty only by knowing that the ostrich roars by day and the lion by night. The African lion is of a tawny colour, like that of some mastiffs. The mane in the male is large, and gives the idea of great power. In some lions the ends of the hair of the mane are black: these go by the name of black-maned lions; though as a whole all look of the yellow tawny colour. It is questionable if a single lion ever attacks a full-grown buffalo. The amount of roaring heard at night, on occasions when a buffalo is killed, seems to indicate there are always more than one lion engaged in the onslaught.

On the plain, south of Sebituane's ford, a herd of buffaloes kept a number of lions from their young by the males turning their heads to the enemy. The young and the cows were in the rear. One toss from a bull would kill the strongest lion that ever breathed. I have been informed that in one part of India even the tame buffaloes feel their superiority to some wild animals, for they have been seen to chase a tiger up the hills, bellowing as if they enjoyed the sport. Lions never go near any elephants, except the calves, which, when young, are sometimes torn by them. Every living thing retires before the lordly elephant, yet a full-grown one would be an easier prey than the rhinoceros; the lion rushes off at the mere sight of this latter beast."

Few men had more experience of lions than Livingstone, and no traveller deserves greater credence. Grand beast though he be, we prefer to give him his character according to Livingstone than according to the foolish, though marvellous, stories often told in popular works on natural history. Of his great strength there can be no doubt, and our traveller had once a terrible experience thereof, he tells us:—

"Returning towards Kuruman, I selected the beautiful valley of Mabotsa (lat. 25° 14′ south, long. 26° 30′?) as the site of a missionary station, and thither I removed in 1843. Here an occurrence took place, concerning which I have frequently been questioned in England, and which, but for the importunities of friends, I meant to have kept in store to tell my children when in my dotage. The Bakátla of the village Mabotsa were much troubled by lions, which leaped into the cattle-pens by night and destroyed their cows. They even attacked the herds in open day. This was so unusual an occurrence that the people believed that they were bewitched—'given,' as they said, 'into the power of the lions by a neighbouring tribe.' They went once to attack the animals, but being rather a cowardly people compared to Bechuanas in general on such occasions, they returned without killing any. It is well known that if one in a troop of lions is killed, the others take the hint and leave that part of the country. So the next time the herds were attacked, I went with the people, in order to encourage them to rid themselves of the annoyance by destroying one of the marauders. We found the lions on a small hill, about a quarter of a mile in length, and covered with trees. A circle of men was formed round it, and they gradually closed up, ascending pretty near to each other. Being down below on the plain with a native schoolmaster, named Mebálwe, a most excellent man, I saw one of the lions sitting on a piece of rock within the now closed circle of men. Mebálwe fired at him before I could, and the ball struck the rock on which the animal was sitting. He bit at the spot struck as a dog does at a stick or stone thrown at him, then leaping away, broke through the opening circle, and escaped unhurt. The men were afraid to attack him, perhaps on account of their belief in witchcraft. When the circle was re-formed, we saw two other lions in it, but we were afraid to fire lest we should strike the men; and they allowed the beasts to burst through also. If the Bakátla had acted according to the custom of the country, they would have speared the lions in their attempt to get out. Seeing we could not get them to kill one of the lions, we bent our footsteps toward the village; in going round the end of the hill, however, I saw one of the beasts sitting on a piece of rock as before, but this time he had a little bush in front. Being about thirty yards off, I took a good aim at his body through the bush, and fired both barrels into it. The men then called out 'He is shot! he is shot!' Others cried 'He has been shot by another man, too; let us go to him!' I did not see any one else shoot at him, but I saw the lion's tail erected in anger behind the bush, and turning to the people, said, 'Stop a little till I load again.' When in the act of ramming down the bullets I heard a shout. Starting, and looking half round, I saw the lion just in the act of springing upon me. I was upon a little height. He caught my shoulder as he sprang, and we both came to the ground below together. Growling horribly close to my ear, he shook me as a terrier dog does a rat. The shock produced a stupor similar to that which seems to be felt by a mouse after the first shake of the cat. It caused a sort of dreaminess, in which there was no sense of pain nor feeling of terror, though quite conscious of all that was happening. It was like what patients partially under the influence of chloroform describe, who see all the operation, but feel not the knife. This singular condition was not the result of any mental process. The shake annihilated fear, and allowed no sense of horror in looking round at the beast. This peculiar state is probably produced in all animals killed by the Carnivora; and if so, is a merciful provision by our benevolent Creator for lessening the pain of death. Turning round to relieve myself of the weight, as he had one paw on the back of my head, I saw his eyes directed to

Mebálwe, who was trying to shoot him at a distance of ten or fifteen yards. His gun, a flint one, missed fire in both barrels. The lion immediately left me, and attacking Mebálwe, bit his thigh. Another man, whose life I had saved before, after he had been tossed by a buffalo, attempted to spear the lion while he was biting Mebálwe. He left Mebálwe and caught this man by the shoulder; but at that moment the bullets he had received took effect, and he fell down dead. The whole was the work of a few moments, and must have been his paroxysm of dying rage. In order to take out the charm from him, the Bakátla on the following day made a huge bonfire over the carcase, which was declared to be that of the largest lion they had ever seen. Besides crunching the bone into splinters, he left eleven teeth wounds on the upper part of my arm. A wound from this animal's tooth resembles a gun-shot wound. It is generally followed by a great deal of sloughing and discharge, and pains are felt in the part periodically ever afterwards. I had on a tartan jacket on the occasion, and I believe that it wiped off all virus from the teeth that pierced the flesh; for my two companions in this affray have both suffered from the peculiar pains, while I have escaped with only the inconvenience of a false joint in my limb. The man whose shoulder was wounded showed me his wound actually burst forth afresh on the same month of the following year. This curious point deserves the attention of inquirers."

THE TIGER (*Felis tigris*).

Nearly thirty years afterwards, the remains of this good man having been carried by his faithful servants across half of Africa, were recognised by that stiff elbow, caused by the anchylosis of these splintered bones.

The Tiger (*F. tigris*) is met with in Southern and Eastern Asia. It is nearly equal to the lion in strength, and, perhaps, surpasses him in activity. Its general form and appearance are so well known, that a few words of description will suffice. The tiger has no trace of the shaggy mane which adds so greatly to the bold-looking front of the lion; and his countenance, scowling under the different passions, conveys the idea of wanton treachery and cruelty. In shape he is more slender and lengthened than the lion; the head is rounder, the whole form is more cat-like, and all his motions are performed with apparent ease and the greatest grace.

A tiger, in good health, having the hair thick, fine, and shining, the colour bright tawny yellow, shaded into pure white on the under parts, and beautifully marked with dark bands and brindlings, exhibits a distribution of colour not only pleasing, but beautiful. These markings vary in number and intensity of shade in the young, and in females; and very young tigers are of a grey colour, with obscure dusky transverse bands.

Tiger hunting is a very popular pursuit in India. The following graphic account of a tiger hunt, of which he was an eye-witness, is from the pen of Dr. Heber, the well-known Bishop of Calcutta:—" At Kulleanpoor, the young Rajah Gourman Singh mentioned, in the course of conversation, that there was a tiger in the adjoining tope, which had done a good deal of mischief; that he should have gone after it himself had he not been ill, and had he not thought it would be a fine diversion for Mr. Boulderson, the collector of the district, and me. I told him I was no sportsman; but Mr. Boulderson's eyes sparkled at the name of tiger, and he expressed great anxiety to beat up his quarters in the afternoon. Under such circumstances, I did not like to deprive him of his sport, as he would not leave me by myself, and went, though with no intention of being more than a spectator. Mr. Boulderson, however, advised me to load my pistols, for the sake of defence, and lent me a very fine double-barrelled gun for the same purpose. We set out a little after three on our elephants, with a servant behind each houdah,* carrying a large chatta, which, however, was almost needless. The Rajah, in spite of his fever, made his appearance too, saying that he could not bear to be left behind. A number of people, on foot and horseback, attended from our camp and the neighbouring villages, and the same sort of interest and delight was evidently excited which might be produced in England by a great coursing party. The Rajah was on a little female elephant, hardly bigger than a Durham ox, and almost as shaggy as a poodle. She was a native of the neighbouring wood, where they are generally, though not always, of a smaller size than those of Bengal and Chittagong. He sat in a low houdah, with two or three guns ranged beside him ready for action. Mr. Boulderson had also a formidable apparatus of muskets and fowling-pieces projecting over his mahout's head.

" At last the elephants all drew up their trunks into the air, and began to roar and stamp violently with their fore feet. The Rajah's little elephant turned short round, and, in spite of all her mahout (driver) could say or do, took up her post, to the Rajah's great annoyance, close in the rear of Mr. Boulderson. The other three (for one of my baggage elephants had come out too, the mahout, though unarmed, not caring to miss the show) went on slowly, but boldly, with their trunks raised, their ears expanded, and their sagacious little eyes bent intently forward. 'We are close upon him,' said Mr. Boulderson; 'fire where you see the long grass shake, if he rises before you.' Just at that moment my elephant stamped again violently. 'There, there!' cried the mahout; 'I saw his head.' A short roar, or rather growl, followed, and I saw, immediately before my elephant's head, the motion of some large animal stealing through the grass. I fired as directed, and, a moment after, seeing the motion still more plainly, fired the second barrel. Another short growl followed; the motion was immediately quickened, and was soon lost in the more distant jungle. Mr. Boulderson said:—'I should not wonder if you hit him that last time; at any rate, we shall drive him out of the cover, and then I will take care of him.' In fact, at that moment, the crowd of horse and foot spectators at the jungle side began to run off in all directions. We went on to the place, but found it was a false alarm; and, in short, we had seen all we were to see of him, and went twice more through the jungle in vain.

" I asked Mr. Boulderson, on our return, whether tiger hunting was generally of this kind, which I could not help comparing to that chase of bubbles which enables us in England to pursue an otter. In a jungle, he answered, it must always be pretty much the same, inasmuch as, except under very peculiar circumstances, or when a tiger felt himself severely wounded, and was roused to revenge by despair, his aim was to remain concealed, and to make off as quietly as possible. It was after he had broken cover, or when he found himself in a situation so as to be fairly at bay, that the serious part of the sport began, in which case he attacked his enemies boldly, and always died fighting. He added, that the lion, though not so large or swift an animal as the tiger, was generally stronger and more courageous. Those which have been killed in India, instead of running away when pursued, through a jungle, seldom seem to think its cover necessary at all. When they see their enemies approaching, they spring out to meet them, open-mouthed, in the plain, like the boldest of all animals—a mastiff dog. They are thus generally shot with very little trouble; but if they are missed, or only slightly wounded, they are truly formidable enemies. Though not swift, they leap with vast strength and violence; and their large heads, immense paws, and the great weight of their body forwards, often enable them to spring on the head of the largest elephants, and fairly pull them down to the ground, riders and all. When a tiger springs on an elephant, the latter is generally able to shake him off under his feet; and then, woe be to him! The elephant either kneels on him, and crushes him at once, or gives him a kick, which breaks half his ribs, and sends him flying, perhaps, twenty paces. The elephants, however, are often dreadfully torn; and a large old tiger sometimes clings too fast to be thus dealt with. In this case, it often happens that the elephant himself falls from pain, or from the hope of rolling on his enemy; and the people on his back are in very considerable danger, both from friends and foes; for Mr. Boulderson said the scratch of a tiger was sometimes venomous, as that of a cat is said to be. But this does not often happen; and, in general, persons wounded by his teeth or claws, if not killed outright, recovered easily enough."

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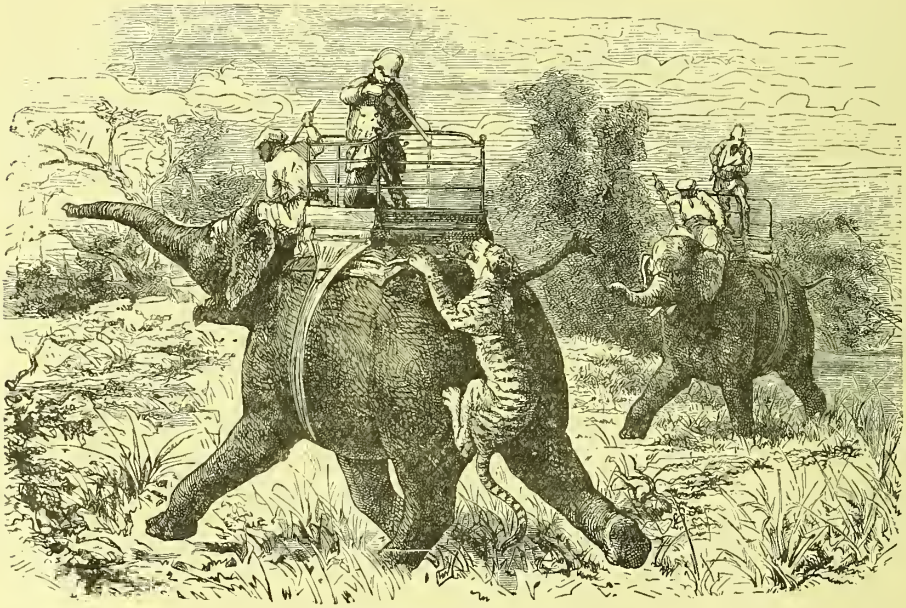
* The houdah is a seat somewhat resembling the body of a gig, and is fastened by girths to the back of the elephant.



TIGER HUNTING IN INDIA.

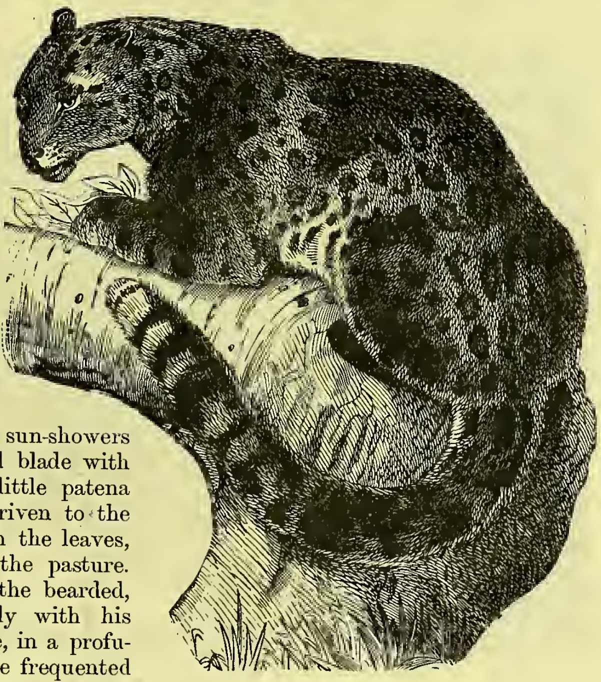
The Leopard (*F. pardus*), sometimes called Panther, is found in Southern Asia and Africa. It is very variable in both the size and number of its spots. It is usually about four feet in length, exclusive of the tail, which is about two feet and a half long. It is of a rich yellowish fawn colour, which is paler on the sides, and lost in the pure white of the belly. It is covered with a variety of annular or oval black spots, and the sides and part of the tail are occupied by numerous distinct roses, formed by the near approach of three or four elongated small dark spots, which surround a central area, about an inch in breadth, of a somewhat deeper colour than the ground on which it is placed. There are some black lines on the lips, and bands of the same colour on the insides of the legs; two or three imperfect black circles, alternating with white, also occur towards the extremity of the tail.

He climbs trees with such astonishing rapidity that few animals are safe from his ravages. Man alone seems to be respected by him; but, if pressed hard by the hunter, the leopard will turn upon him, and it requires both skill and prowess to guard against the fury of his attacks.

In the year 1708, Kolben relates that two leopards, a male and female, with three cubs, entered a sheepfold at the Cape of Good Hope. The old ones killed nearly a hundred sheep, and regaled themselves on the blood. When they were satiated, they tore a carcase into three pieces, and gave a part to each of their young ones. They then took each a whole sheep; and, thus laden, began to move off, but were discovered in their retreat; and the female, with the young ones, was killed, while the male effected his escape.

The opinion of Major Skinner, who was for more than fifty years in the interior of Ceylon, is quoted by Sir Emerson Tennent in favour of the leopard's pacific disposition towards man, adding the following extract of a letter from the major in illustration of it:—

"On the occasion of one of my visits to Adam's Peak, in the prosecution of my military reconnaisances of the mountain zone, I fixed on a pretty little patena (*i.e.*, meadow), in the midst of an extensive and dense forest in the southern segment of the Peak Range, as a favourable spot for operations. It would have been difficult, after descending from the cone of the peak, to have found one's way to this point, in the midst of so vast a wilderness of trees, had not long experience assured me that good game tracks would be found leading to it; and by one of them I reached it. It was in the afternoon, just after one of those tropical sun-showers which decorate every branch and blade with its pendent brilliants, and the little patena was covered with game, either driven to the open space by the drippings from the leaves, or tempted by the freshness of the pasture. There were several pairs of elk, the bearded, antlered male contrasting finely with his mate, and other varieties of game, in a profusion not to be found in any place frequented by man. It was some time before I could allow them to be disturbed by the rude fall of the axe, in our necessity to establish our bivouac for the night, and they were so unaccustomed to danger that it was long before they took alarm at our noises.



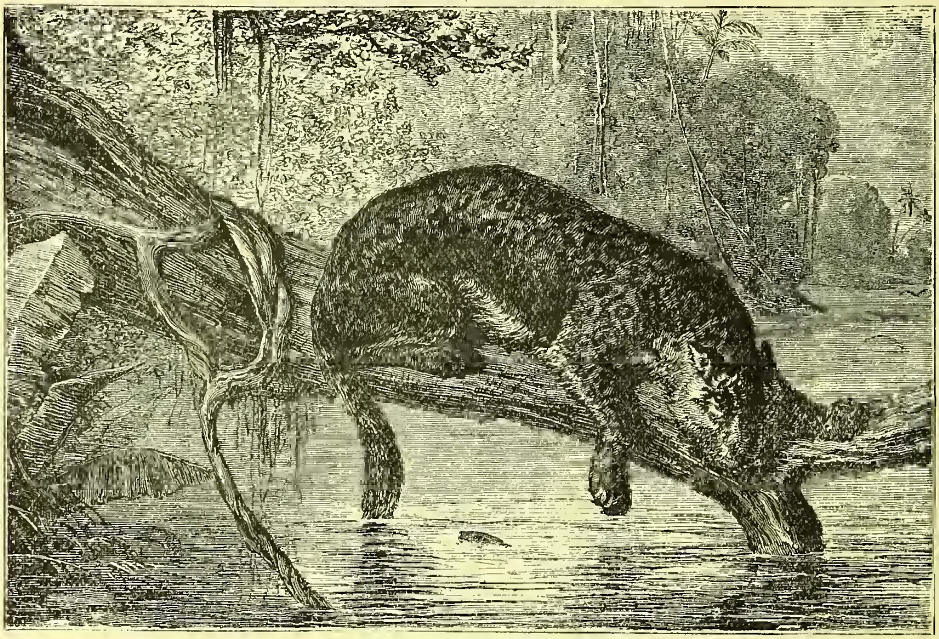
THE LEOPARD (*Felis pardus*).

"The following morning, anxious to gain a height in time to avail myself of the clear atmosphere of sunrise for my observations, I started off by myself through the jungle, leaving orders for my men, with my surveying instruments, to follow my track by the notches which I cut in the bark of the trees. On leaving the plain, I availed myself of a fine wide game-track, which lay in my direction, and had gone perhaps half a mile from the camp, when I was startled by a slight rustling in the nilloo (a species of *Strobilanthes*) to my right, and in another instant, by the spring of a magnificent leopard, which, in a bound full eight feet in height over the lower brushwood, lighted at my feet, within eighteen inches of the spot whereon I stood, and lay in a crouching position, his fiery, gleaming eyes fixed upon me.

"The predicament was not a pleasant one. I had no weapon of defence, and, with one spring or blow of his paw, the beast could have annihilated me. To move I knew would only encourage his attack. It occurred to me at the moment that I had heard of the power of man's eye over wild animals, and accordingly I fixed my gaze as intently as the agitation of such a moment enabled me on his eyes. We stared at each other for some seconds, when, to my inexpressible joy, the beast turned and bounded down the straight open path before me. This scene occurred just at that period of the morning when the grazing animals retired from the open patena to the cool shade of the forest; doubtless, the leopard had taken my approach for that of a deer, or some such animal. And if his spring had been at a quadruped instead of a biped, his distance was so well measured, that it must have landed him on the neck of a deer, an elk, or a buffalo; as it was, one pace more would have done for me. A bear would not have let his victim off so easily."

The Jaguar (*F. onca*) is often called the American leopard. It is found in South America. Mr. Bennett, contrasting it with the leopard, says:—

"These differences of form are accompanied by differences of colour and markings equally decisive. The general appearance is, at the first glance, the same in both; but the open roses of the leopard are scarcely more than half the size of those of the jaguar, and they all enclose a space of one uniform colour, in which, unless in some rare and accidental instances, no central spots exist; while in the latter animal, most of those which are arranged along the upper surface, near the middle line of the back, are distinguished by one or two small black spots enclosed within their circuit. The middle line itself is occupied in the leopard by open roses, intermixed with a few black spots, of small size and roundish form; that of the jaguar, on the contrary, is marked by one or two regular longitudinal lines of broad, elongated, deep-black patches, sometimes extending several inches in length, and occasionally forming an almost continuous band from between the shoulders to the tail. The black rings towards the tip of the latter are also more completely circular than in the leopard."

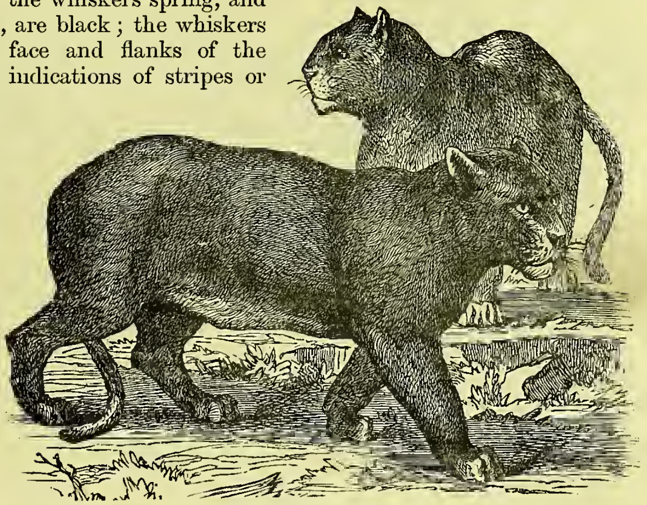


THE JAGUAR (*Felis onca*).

Humboldt thus describes the nocturnal life of the jaguar, in his journals:—

"A striking evidence of the impenetrability of particular parts of the forest is afforded by a trait, related by an Indian, of the habits of the large American tiger, or panther-like jaguar. While in the Llanos of Verinas and the Meta, and in the Pampas of Buenos Ayres, the introduction of European cattle, horses, and mules has enabled the beasts of prey to find an abundant subsistence; so that, since the first discovery of America, their numbers have increased exceedingly in those extended grassy steppes. Their congeners in the dense forests around the sources of the Orinoco lead a very different and far less easy life. In a bivouac, near the junction of the Cassiquaire with the Orinoco, we heard the cries of the jaguar extremely near to us; and, as the clouded sky made astronomical observations impossible, we passed part of the night in making our interpreter repeat to us the accounts given by our native boat's crew of the tigers of the country. The black jaguar was, they said, not unfrequently found there: it is the largest and most bloodthirsty variety, with the black spots scarcely distinguishable on its deep-brown skin. It lives at the foot of the mountains of Maraguaca and Unturan. One of the Indians of the Durimund tribe then related to us that jaguars are often led, by their love of wandering and by their rapacity, to lose themselves in such impenetrable parts of the forest, that they can no longer hunt along the ground, and live, instead, in the trees, where they are the terror of the families of monkeys."

The Puma (*F. concolor*) is another American species; it is sometimes called the American lion. The total length of the body of the adult is from four feet to four feet and a half, that of the tail from two feet to two feet and a half. The females are somewhat less. The fur is thick and close, above of a reddish-brown, approaching nearly to the colour of a fox on the back. It lightens on the outsides of the limbs and on the flanks, and on the belly becomes of a pale reddish-white. The muzzle, chin, throat, and insides of the legs, are greyish-white, and on the breast the colour becomes more marked, and is almost pure white. The part from which the whiskers spring, and the lips and backs of the ears, are black; the whiskers themselves white. On the face and flanks of the young animal there are some indications of stripes or brindling; but when the puma reaches maturity these are lost, and the colour becomes entirely uniform, except where it shades into a paler tint. Though very active in climbing, this animal seems more to frequent the grassy plains of the southern part of America, and the marshy meadow lands bordering the rivers, than the forest, and is found in a country so open, as to be frequently taken by the lasso, when attacking the herds. In the northern districts it inhabits the swamps and prairies, living chiefly on different species of deer, on which it is said sometimes to drop down from a tree, which it had ascended to watch their path; or it makes inroads on the bogs of the squatter, who has gone to the unopened country. Other kinds of food, however, are sought after, and taken without much discrimination. Unlike most other animals, it is not satisfied with the seizure of a single prey; but, when meeting with a herd of animals, will kill as many as it can, sucking only a small portion of the blood from each. It is thus extremely destructive among sheep, and has been known to kill fifty in one night. Active means are therefore constantly required for its destruction; and it is either hunted, speared, or shot.



THE PUMA (*Felis concolor*).

The following curious encounter with a puma is related by Sir E. Head, in his "Journey Across the Pampas:"—"The fear which all wild animals in America have of man is very singularly seen in the Pampas. I often rode towards the ostriches and zamas, crouching under the opposite side of my horse's neck, but I always found that, although they would allow any loose horse to approach them, they, even when young, ran from me, though little of my figure was visible; and when I saw them all enjoying themselves in such full liberty, it was at first not pleasing to observe that one's appearance was everywhere a signal to them that they should fly from their enemy. Yet it is by this fear 'that man hath dominion over the beasts of the field;' and there is no animal in South America that does not acknowledge this instinctive feeling."

The puma is very easily tamed, and becomes harmless, and even affectionate. Kean, the actor, possessed one, called "Tom," which followed him about, and was often introduced to company in his drawing-room. Another was extremely gentle and playful, and showed no symptoms of ferocity to strangers who went to see it. It rejoiced greatly in the society of those to whose company it was accustomed; laid down on its back between their feet, and played with the skirts of their garments, exactly like a kitten. It was very fond of water, frequently jumping into and out of a large tub, rolling itself about, and apparently greatly pleased with the refreshment.

It was brought from the city of St. Paul's, the capital of the district of that name, in the Brazils. During its voyage, it was in habits of intimacy with several dogs and monkeys, none of which it ever attempted to injure; nor did it even attempt to return the petty insults which the latter sometimes offered. But if an unfortunate fowl or goat came within its reach, it was immediately snapped at and killed. While in London, it escaped into the street during the night, but allowed itself to be taken by a watchman, without offering even a show of resistance. After its arrival in Edinburgh, it was not indulged with living prey; and the only animals which had fallen victims to its rapacity, when we last heard of it, were a mallard and cock-pheasant, both of which approached inadvertently within the circle of its spring, and were each killed by a blow of its fore paw.

The Ocelot (*F. pardalis*) is one of the most beautiful of its tribe, and is less in size than the leopard; its length, exclusive of the tail, is about three feet, and its height about eighteen inches. The colour of its fur is grey, slightly tinged with pale fawn; the whole body and legs are covered with longitudinal chain-like stripes, broken into patches of some inches, black at the margins, and pale inside, with an open space in the centre, of the ordinary ground colour of the fur; on the neck and head these black lines have no central opening. The colours of the female are less vivid than those of the male.

This animal is a native of South America, where it frequents the depths of the forest, living on deer and birds. It seldom attacks man, though instances have occurred of its doing so. When hunted and overtaken, it defends itself with great obstinacy. Its natural disposition, however, is timid and rather cowardly.

The Clouded Tiger (*F. macrocelis*) seems to be of a less mischievous disposition than many of the other cats. In the forests of Sumatra, it lives much upon the trees, pursuing and feeding on birds; and it is said by the natives to be in the habit of sleeping stretched across the fork of a large bough. "While in a state of confinement," says Sir Stamford Raffles, "these animals were remarkable for good temper and playfulness. No domestic kitten could be more so; they were always courting intercourse with persons passing by; and in the expression of their countenance, which was always open and smiling, showed the greatest delight when noticed, throwing themselves on their backs, and delighting in being tickled and rubbed. On board ship there was a small Musi dog, who used to play round the cage with the animal, and it was amusing to observe the playfulness and tenderness with which the latter came in contact with his inferior-sized companion. When fed with a fowl that had died, he seized the prey, and, after sucking the blood and tearing it a little, he amused himself for hours in throwing it about and jumping after it, in the manner that a cat plays with a mouse before it is quite dead.

"He never seemed to look on man or children as prey, but as companions; and the natives assert that when wild these animals live principally on poultry, wild birds, and the smaller kinds of deer. They are not found in numbers, and may be considered rather a rare animal, even in the southern part of Sumatra. Both specimens were procured from the interior of Bencoolen, on the banks of the Bencoolen River; and constantly amused themselves in jumping and clinging to the top of their cage, and throwing a somersault, or twisting themselves round in the manner of a squirrel when confined, the tail being extended, and showing to great advantage when so expanded."

The Serval (*F. serval*) is found on the South and West of Africa. The Wild Cat (*F. catus*) of Europe is by some thought to be distinct from the Asiatic and African forms. That it is specifically distinct from our domestic race is now universally admitted; at the same time, it often happens that individuals of the latter breed betake themselves to the woods, or to extensive preserves of game, where, finding their supply of food abundant, they permanently establish themselves, and lead an independent life. It is often asserted that the *wild* and *tame* cat breed together; but there is every reason to believe that the wild cat in such cases is one of the domestic species, leading an independent life. Such animals have been known to haunt coppices and woods in the vicinity of farmhouses, and to commit extensive ravages among the poultry and pigeons.

The grounds on which the specific distinction between the domestic cat and the wild cat is now admitted, consist in their decided difference of general conformation: besides standing higher on the limbs, the body of the wild cat is much more robust than in the tame; the tail is shorter, and, instead of tapering, terminates somewhat abruptly, being even fuller at its extremity than at its base; it is also invariably tipped with black. The lips and soles of the feet are also black. In the domestic cat the head is rounded and moderate, the body slender, the tail long and tapering, the colours variable.

The wild cat is found throughout Europe, wherever extensive woods afford it an asylum. It is common in the forests of Germany, Hungary, Russia, and the western parts of Asia; and, though scarce, is not yet extirpated in the British Islands. Its chief strongholds are among the mountains of Scotland, of the northern counties of England, and of Wales and Ireland—the larger woods being its place of resort, and of concealment by day. Here it lurks on the branches of large trees, in the hollows of decayed trunks, and in the clefts and holes of rocks, issuing forth at night to seek its prey. On hares, rabbits, grouse, partridges, and all kinds of game, it commits sad havoc; and the feathers of its victims, scattered about, often betray its presence in the neighbourhood, and rouse the indignation and fatal onslaught of the gamekeeper. Young lambs and fawns are by no means safe from its attack; indeed, of all our native beasts of prey at present living within the precincts of our island, it is the fiercest and most destructive.

THE SERVAL (*Felis serval*).

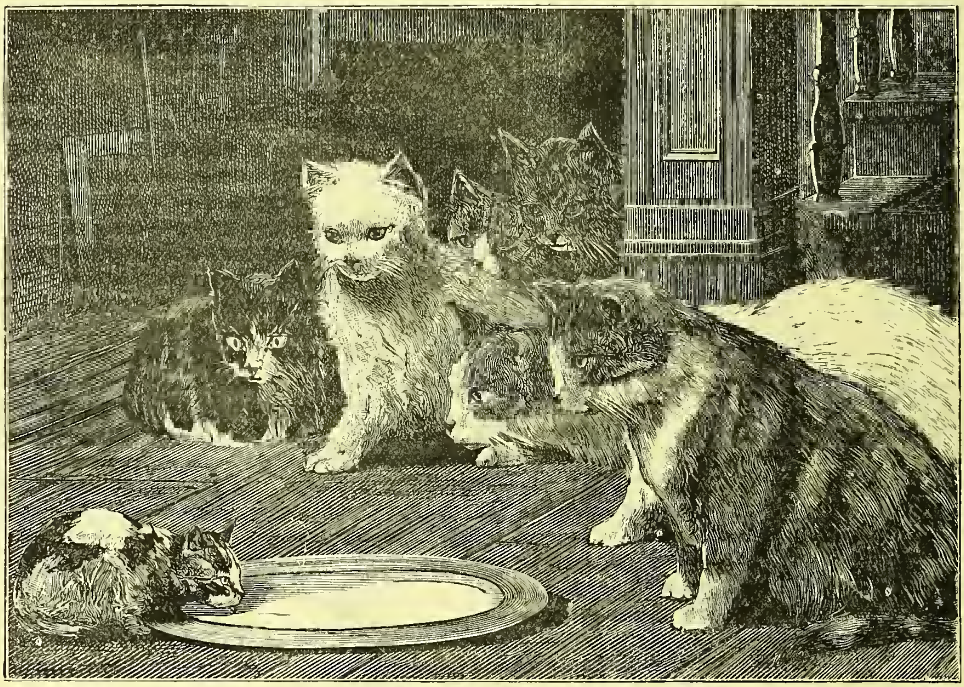
The female pertinaciously defends her young, and, while she is engaged with them, it is not safe to disturb her in her retreat. She usually produces four or five at a birth, making a bed for them in a hollow tree or the fissure of a rock, and sometimes she even usurps the nest of a large bird in which to rear her young.

The fur of the wild cat is full and deep; on the face it is of a yellowish-grey colour, passing into greyish-brown on the head. Several interrupted black stripes extend from the forehead, and pass between the ears to the occiput. The general colour of the body is dark grey, a dusky-black stripe running down the spine, while beautiful transverse wavings of an obscure blackish-brown adorn the sides. The tail is ringed with the same tint, except at the tip, which is black.

The Domestic Cat (*F. domestica*) is supposed to be a native of Syria, but has been introduced into most countries as a domestic animal. The normal colour would seem to be that of the tabby cat. When black, white, or yellow, it is called tortoiseshell. The fur varies greaty in length. It is very short, close, and almost erect from the skin in the rabbit cats; it is very long, silky, and fluffy in the Angora or Angola cat. The tail is usually long and somewhat tufted in the so-called Persian cat; it is very short, or almost entirely wanted, in the Isle of Man cats and the Japan cats. The ears, generally erect, are pendulous in the Chinese cats.

Mr. Hodgson thinks the domestic cat is derived from F. nipalensis. The cat has been domiciled for many ages among the Phœnicians, Egyptians, and Jews, and may be traced in the mythology of some of these nations. In such veneration was the cat held among the Egyptians, that if one died a natural death, it was lamented with certain appointed symbols of grief.

When M. Sonnini was in Egypt he had an Angora cat, which remained for a long time in his possession. It was one of the most beautiful of its kind, and its manners rendered it equally attractive. In Sonnini's solitary moments it chiefly kept by his side. It interrupted him frequently in the midst of his labours or meditations by little affecting caresses, and generally followed him in his walks. During his absence, it sought and called for him incessantly with the greatest inquietude; and if it were long before he re-appeared, it would quit his apartment, and attach itself to the person of the house where he lived, for whom, next to himself, it entertained the greatest affection. It recognised his voice at a distance, and seemed to increase in satisfaction with him. Its look was as gentle as its character, and its gait was frank. In a word, it possessed the disposition of the most amiable dog beneath the brilliant fur of a cat. "This animal," says M. Sonnini, "was my principal amusement for several years. How was the expression of its attachment depicted on its countenance! How many times have its tender caresses made me forget my troubles, and consoled me in my misfortunes! My beautiful and interesting companion at length perished. After several days of suffering, during which I never forsook it, its eyes, constantly fixed on me, were at length extinguished; and its loss rent my heart with sorrow."



DOMESTIC CATS (*Felis domestica*).

There is a variety with the hair very much lengthened and very silky, perhaps more so than that of the Angora cat, called the Persian cat. It is, however, differently coloured, being of a fine uniform grey on the upper part, with the texture of the fur as soft as silk, and the lustre glossy; the colour fades off on the lower parts of the sides, and passes into white, or nearly so, on the belly. This is probably one of the most beautiful varieties, and it is exceedingly gentle in its manners.

The breed of cats without tails is well known in the Isle of Man, and accounted by its people as one of its greatest curiosities. The hind legs of these animals are rather larger than those of the cats with tails, giving them somewhat of a rabbit-like aspect. Hence it was at one time supposed that they were a cross between the cat and the rabbit. The tailless cats are said to be good mousers.

Professor Rolleston has, we think, conclusively shown that the ancient Greeks and Romans had not, in classical times, domesticated the cat; that, except in Egypt, it was probably not domesticated in any country before the Christian era; that its domestication in Western Europe, however, dates back to a very early period, there being evidence to show that the cat and the common marten were kept as domesticated animals side by side, and at the same date, in Italy, nine hundred years before the period of the Crusades. And he considers that the white-breasted marten (*Mustela foina*) was kept in a domesticated state by the Greeks and Romans, and is the "cat" or *γαλή* of the ancients.

Other species of this genus we must pass over, to mention those of the next genus, Lyncus.

THE EUROPEAN LYNX (*Lyncus borealis*).

The European Lynx (*L. borealis*) is found in the Polar regions of Asia and Europe. It is not uncommon in some parts of Sweden and Norway. At one time it was to be met with in the range of the Jura; and specimens have been met with in Switzerland so recently as 1820 and 1827. It is still to be found in the mountainous districts of Germany, Russia, and Spain.

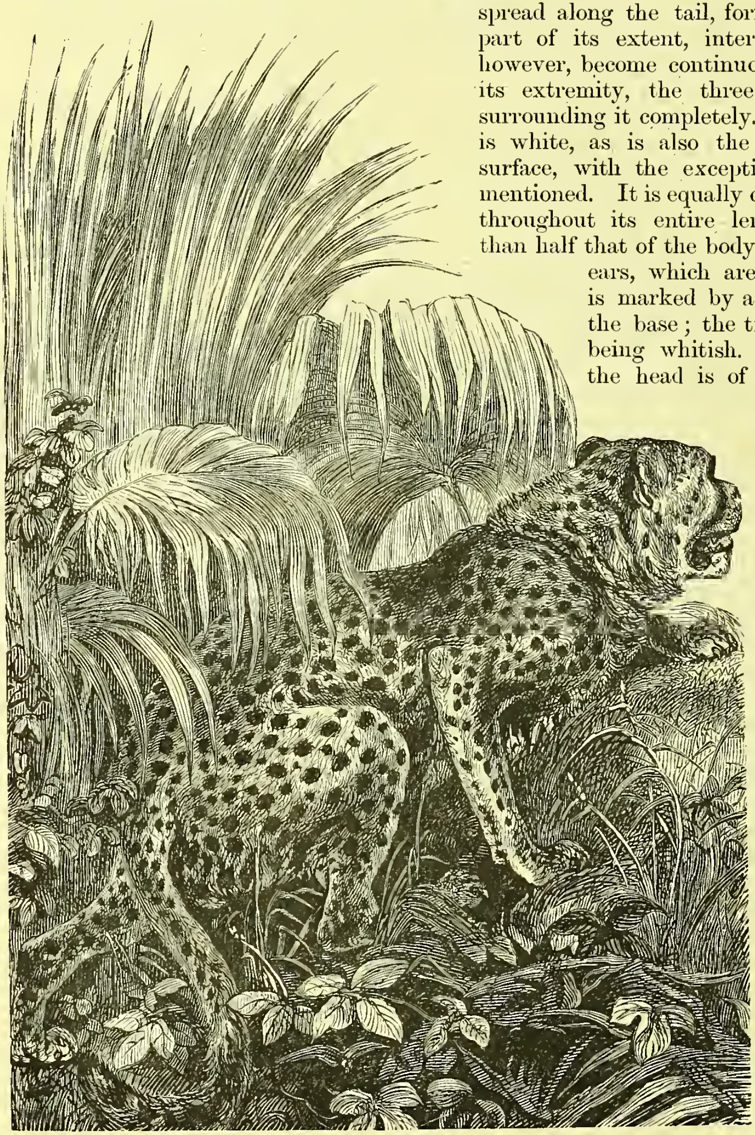
The fur of this animal is long, of a dull reddish-grey above, with oblong spots of reddish-grey on the sides; the spots on the limbs rounder and smaller; it is whitish below, mottled with black. The length is about three feet. In winter the fur is much longer than it is in summer, and has a hairy appearance in the former season, owing to the long hair being then tipped with a greyish-white. The tail, which is black at the end, is not more than six or seven inches in length. This lynx feeds on small quadrupeds and birds, in search of which it often climbs trees.

L. pardinas is a smaller animal, met with in Portugal and some parts of Southern Europe. L. isabellinus is found in Thibet; and several species are met with in America, not, however, going further south than Mexico. The Caracal (*L. caracal*) extends to Central India from Arabia and Persia, and is found from North Africa even to the Cape of Good Hope.

The genus Cynœlurus contains only the Hunting Leopard or Cheetah (*C. guttata*, the *Felis jubata* of authors). This species ranges from Southern and Western India through the Holy Land, then along Northern and Central Africa to the Cape of Good Hope.

Intermediate in size and shape between the leopard and the hound, he is slenderer in his body, more elevated on his legs, and less flattened on the fore part of his head than the former, while he is deficient in the peculiarly graceful and lengthened form, both of head and body, which characterises the latter. His tail is entirely that of a cat; and his limbs, although more elongated than in any other species of that group, seem to be better fitted for strong muscular exertion than for action and long-continued speed.

The ground colour of the cheetah is bright yellowish fawn above, nearly pure white beneath; covered above and on the sides by innumerable closely-approximating spots, from half an inch to an inch in diameter, which are intensely black, and do not, as in the leopard and others of the spotted cats, form roses with a lighter centre, but are full and complete. These spots, which are wanting on the chest and under part of the body, are larger on the back than on the head, sides, and limbs. There they are more closely set; they are also spread along the tail, forming, on the greater part of its extent, interrupted rings, which, however, become continuous as they approach its extremity, the three or four last rings surrounding it completely. The tip of the tail is white, as is also the whole of the under surface, with the exception of the rings just mentioned. It is equally covered with long hair throughout its entire length, which is more than half that of the body. The outside of the ears, which are short and rounded, is marked by a broad black spot at the base; the tip, as also the inside, being whitish. The upper part of the head is of a deeper tinge; and there is a strongly-marked flexuous black line, of about half an inch in breadth, extending from the inner angle of the eye to the angle of the mouth. The extremity of the nose is black, like that of a dog. The fur has little of the sleekness that characterises the cat's, but exhibits, on the contrary, a peculiar crispness not to be found in any other animal of the tribe.


THE CHEETAH (*C. guttala*).

Chardin, Bernier, Tavernier, and others of the older travellers, relate that in several parts of Asia it was customary to make use of a large spotted cat in the pursuit of game, and that this animal was called souze in Persia, and cheetah in India; but so imperfect were their statements, that it was next to impossible to recognise the particular species intended.

FAMILY XXV.—CRYPTOPROCTIDÆ.

This family contains but a single species (Cryptoprocta ferox), found in Madagascar, and described, many years ago (1833), by Mr. Bennett. It is a small and cat-like animal, with a conical head, long, stiff whiskers, large ears covered with short hairs. The nose is naked, flat, and grooved; tail is elongate; legs moderate, of nearly equal length. Soles of the feet with six pads—fore ones wider in front, hinder ones oblong; toes united by a web. Mr. Telfair describes it "as having an anal pouch, and having the odour of a skunk. When at liberty it lay constantly in a rolling position, sleeping always on its side, or even on its back, and holding with its fore feet the small wires of its cage." We follow Professor Flower's classification of the Carnivora in making this strange form into a family to immediately precede that of the Civets.

THE INDIAN CIVET (*Viverra zibetha*).

FAMILY XXVI.—VIVERRIDÆ.

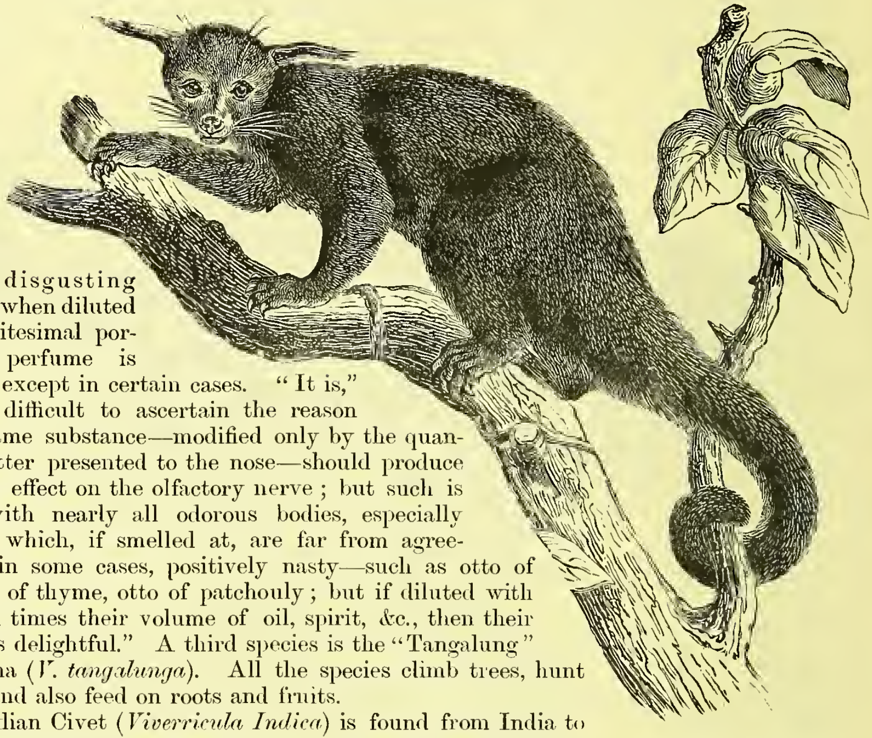
This family contains upwards of one hundred species of small-sized carnivorous animals, known as Civets, Genets, Paradoxures, and Ichneumons. The species are mostly African and South Asiatic. A few are found in Southern Europe, but they are not to be met with in America, Australia, or Northern Europe or Asia. An essential character of this family is to have two tubercular grinders on each side of the upper jaw, and one on each side of the lower. Dr. J. E. Gray divides this family into three sub-families.

THE GENET (*Genetta vulgaris*).

Sub-family 1.—The Civets (*Viverrinæ*).

This sub-family contains some thirteen genera and about thirty-three species. Most of them are digitigrade, but in some the under side of the toes, and more or less of the back of the tarsus, is naked and callous. The tail is generally not as long as the body, and in one genus (Arctictis) is prehensile. The fur is soft and elastic, except in Arctictis.

The African Civet Cat (*Viverra civetta*) is found in the Gaboon, at Fernando Po, and Abyssinia; and the Indian Civet (*V. Zibetha*) in Asia, Bengal, and as far north as Nepaul, China, and Formosa. From both species is the fatty substance obtained which is known in perfumery and in medicine by the name of civet. It is semi-fluid, and smells strongly of musk. On this subject, Mr. Piesse observes:—"In its pure state, civet has to nearly all persons a most disgusting odour; but, when diluted to an infinitesimal portion, its perfume is agreeable," except in certain cases. "It is," he adds, "difficult to ascertain the reason why the same substance—modified only by the quantity of matter presented to the nose—should produce an opposite effect on the olfactory nerve; but such is the case with nearly all odorous bodies, especially with ottos, which, if smelled at, are far from agreeable, and, in some cases, positively nasty—such as otto of neroli, otto of thyme, otto of patchouly; but if diluted with a thousand times their volume of oil, spirit, &c., then their fragrance is delightful." A third species is the "Tangalung" of Amboyna (*V. tangalunga*). All the species climb trees, hunt for birds, and also feed on roots and fruits.



THE BINTURONG (*Arctictis binturong*).

The Indian Civet (*Viverricula Indica*) is found from India to Java, and is probably also found on the Comoro Islands, off the African coast.

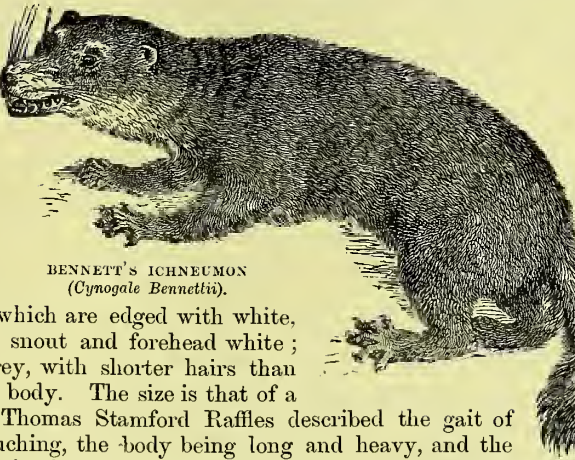
The Genet (*Genetta vulgaris*) has a blackish-grey fur with black spots. Its tail is streaked with some black rings; the tip is white. It frequents the neighbourhood of streams, ascends trees, feeds on rats, mice, &c., and is easily tamed. It inhabits many parts of Southern Europe, France, Spain, also North Africa, and there is little difference between specimens from Spain, Algiers, and Mount Carmel. Species of this genus are met with at the Cape of Good Hope, and on both the east and west coasts of Africa.

Fossa Daubentoni is the name of a genet-like animal from Madagascar, of which almost nothing was known until Mr. Crosseley sent specimens from Madagascar to Dr. Gray in 1872. It appears to want the central black stripe on the back so characteristic of the genets. (See "Proceedings of the Zoological Society" of 1872, p. 869, plate 74.)

THE COMMON PARADOXURE (*Paradoxurus typus*).

Linsang gracilis is found from Malacca to Java, and L. pardicolor in Nepaul.

Galidia elegans is found with two other species in Madagascar. The feet have short, arched, webbed toes, and very acute retractile claws.

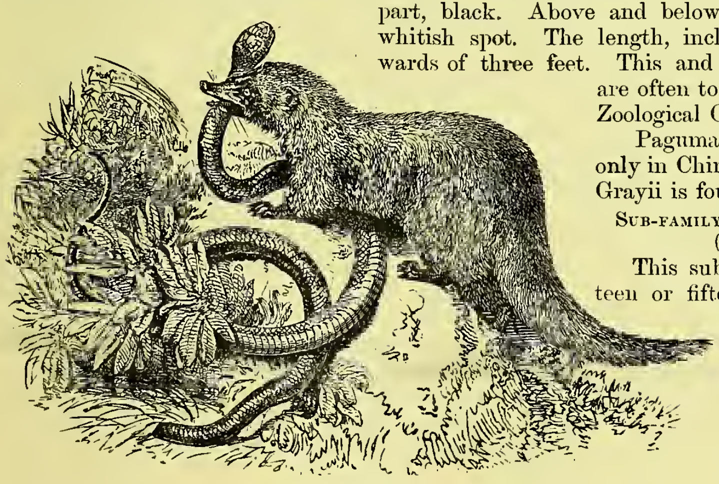


BENNETT'S ICHNEUMON (*Cynogale Bennettii*).

The Binturong (*Arctictis binturong*) is found in Nepaul, and in Sumatra and Java. The fur of this animal is grey; the hairs long, silky, black at the base, and white at their extreme end; shorter on the head and limbs; the sides of the snout, forehead, and pencils of the ears, which are edged with white, black; the upper part of the snout and forehead white; the iris yellow; the belly grey, with shorter hairs than those on the upper part of the body. The size is that of a very large domestic cat. Sir Thomas Stamford Raffles described the gait of the binturong as low and crouching, the body being long and heavy, and the legs short. The tail, thick at its insertion, gradually tapers to the extremity, where it curls upwards. One that was kept alive for many years by Major Farquhar partook both of animal and vegetable food. Slow in motion, and timid in disposition, the animal sleeps much during the day; the night is the season of its comparative activity.

The Paradoxures are in habits like the civets, but their glandular secretion is neither civet nor musk-like. The species are found over the whole of Southern Asia and the Malay Archipelago. There are ten species. One of these, the Common Paradoxure (*Paradoxurus typus*), is common on the plains of India, about Bengal and Madras. Another, the Golden Paradoxure (*P. zeylanicus*), is met with in Ceylon.

Their tail is very peculiar—it is as long as the body, and depressed above and below; the more distant half is, when extended, turned over, so that the lower side is uppermost, and the animal can roll it up spirally. It is of a greyish-black, tinged with yellow, the colour varying in different lights. There is one broad dorsal, and there are three lateral narrower indistinct black lines. The lower jaw, the legs, and the tail are, for the most part, black. Above and below each eye there is a whitish spot. The length, including the tail, is upwards of three feet. This and several other species are often to be seen in the London Zoological Gardens.



THE GREY ICHNEUMON (*Herpestes griseus*).

Paguma larvata is met with only in China or Formosa; but P. Grayii is found in India.

Sub-family 2.—The Ichneumons (*Herpestinæ*).

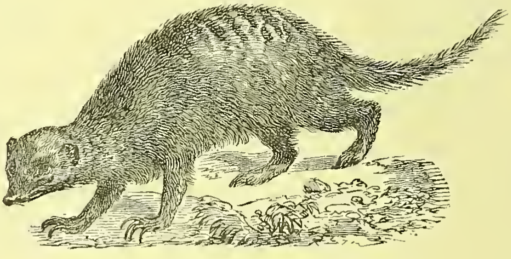
This sub-family contains fourteen or fifteen genera, and about sixty species. They are digitigrade, but instead of being what Dr. Gray well calls cat-footed, as the last sub-family, these are, for the most part, dog-footed; the claws being always exposed and worn as the animal walks, are more or less blunt at the tips.

Cynogale Bennettii is found in Borneo. It has an elongated head, broad nose, small ears, rigid long whiskers, and whisker-like tufts over the eyes and under the ears. The fur is dense, soft, and elastic; tail much shorter than the body; toes short, and slightly webbed.

Galidictis striata and G. vittata are found in Madagascar.

This brings us to the large genus of Ichneumons. The commonest species of the genus Herpestes to be seen in confinement is the Grey Ichneumon (*H. griseus*), which is found in continental India and adjacent countries. It is a bold and sanguinary animal, even in captivity retaining much of its native spirit. One kept in the Tower killed on one occasion no fewer than a dozen full-grown rats, which were loosed to it in a room sixteen feet square, in less than two minutes. They are easily tamed, and become attached to those with whom they live. They have a peculiar antipathy to serpents, and Colonel Sykes states, "They were believed by the Mahratta people to be able in their contests with serpents to neutralise the poison from their bites by eating the root of a plant called monguswail."

The Garangan (*H. javanicus*) is another species found in Java. It is very expert in burrowing in the ground, which process it employs ingeniously in pursuit of rats. It possesses great natural sagacity, and from the peculiarities of its character willingly seeks the protection of man. It is very cleanly in its habits, and is readily tamed; and in a domestic state is docile, and attached to its master, following him like a dog. It is fond of caresses, and frequently places itself erect on its hind legs, regarding everything that passes with great attention. It is of a very restless disposition, and always carries its food to the most retired place in which it is kept to consume it. Being exclusively carnivorous, it is very destructive to poultry, employing great artifice in the surprising of chickens. For this reason we rarely find it in a domestic state among the natives, as one of their principal articles of food is the common fowl, and great quantities are reared in all the villages. This animal, in Java, is chiefly found in large teak forests, at no great elevation above the sea. Its agility is greatly admired by the natives. It attacks and kills serpents with excessive boldness.


THE SURICAT (*Suricata zenik*).

But perhaps the oldest known ichneumon is that from Egypt (*H. ichneumon*), Pharoah's Rat of the French, and Nems of the Egyptians. According to Hasselquist, the ichneumon is met with in Upper and Lower Egypt; living, during the inundation of the Nile, in gardens and near the villages; but in the dry season its dwelling is in the fields, and near the banks of the river. He says it creeps along slowly, as if ready to seize its prey, and that it feeds on plants, eggs, and even fowls, killing the latter in the night, when it frequents the villages. He states also, that in Upper Egypt it searches for the eggs of crocodiles, which lie hid in the sand on the shore, and eats them, preventing, by that means, the increase of these dangerous animals.

This beautiful animal is something larger than a middle-sized cat; its stature being about eight inches, but its figure much larger in proportion. Its motions are characterised by extraordinary quickness, agility, and grace in seizing its prey. The act appears instantaneous, and displays equal boldness, dexterity, and cunning. In its native state its habits are nocturnal. During the day it remains in its hole or burrow, but, as evening comes on, it may be seen stealing forth in pursuit of its prey. Creeping along with the utmost circumspection, as if fully alive to its danger, and yet intent on its enterprise, it examines every recess, peeps into every crevice, and tries the soil by the river-bank, where it is likely the crocodile may have deposited her eggs. These, with snakes, lizards, and all kinds of reptiles, small quadrupeds, and birds, constitute its food. In attacking a snake, it endeavours to spring on the reptile's head, which it crushes between its teeth. This is a feat of no small danger, and in its performance the ichneumon exhibits the most energetic address and activity.

In Egypt it is very commonly domesticated, as a safeguard against reptiles and other vermin which infest the houses of that country. Its manners are not much unlike those of a cat. It will watch for hours at any hole where its prey may be concealed, examine every apartment, and explore every corner. Affectionate and docile, it never attempts to regain its liberty, but becomes attached to its master, recognises his voice, and is pleased with his caresses. Although commonly lively, sportive, and gentle, it only betrays its innate disposition when it has seized its victim. Its eyes, which are red, then become vivid; its hair erect; and, if disturbed, it utters a loud murmur expressive of impatience and ferocity. The uniform colour of the ichneumon is a darkish silvery-grey, the tail terminating in black.

The H. Widdringtoni is the only representative of this large genus found in Europe. It is a native of the Sierra Morena, in Spain.

Three species of the genus Athylax are known—one from Madagascar, two from Africa; and of the fourteen species of the genus Calogale all but two are African.

The Urva of the Nepaulese (*Urva cancrivora*) is described by Mr. Hodgson as in structure and aspect intermediate between Herpestes and Gulo. It is carnivorous and ranivorous, and dwells in burrows in the valleys of the lower and central hilly regions of Nepaul. It has also been taken at Arakan and at Afghanistan.

The species of Cynictis are all South African, and are beautifully figured in Dr. A. Smith's "Illustrations of South African Zoology."

Sub-Family 3.—Rhinogalinæ.

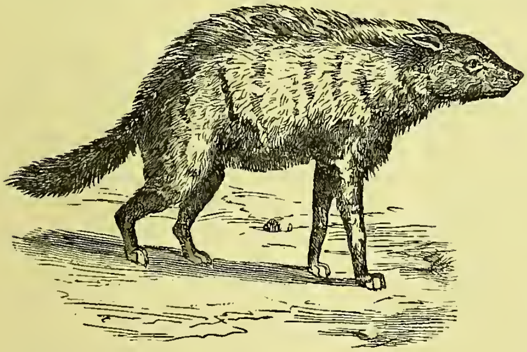
In this family the nose is produced, the under side is convex, covered with short adpressed hairs, without the central bald longitudinal groove which is in a measure characteristic of the last sub-family. The toes are longish, separate, and extended; the claws are blunt, and the fore one is often elongated; the soles of the hind feet are either naked or but slightly covered with hair. There are five genera, and seven species. Of these, all except Eupleres are from the continent of Africa; and E. goudotii is found at Tamatave, Madagascar. Rhinogale Melleri is from East Africa.

The Mungos (*Mungos fasciatus*) is found along the west, south, and east of Africa.

The Kusimansel (*Crossarchus obscurus*) is sometimes brought alive to this country from Western Africa, where it is said to live in deep holes with many openings. The Meer Kat of the Cape of Good Hope, or Suricat (*Suricata zenik*), is only found in South Africa.

FAMILY XXVII.—PROTELIDÆ.

This family contains but a single genus and species—the Aard Wolf of South Africa (*Proteles cristatus = P. lalandii*). This would appear to have the habit as well as appearance of a hyæna, and they have the same mode of endeavouring to save their feet, says Mr. Bartlett, from injury when fighting or defending themselves, by doubling them under them, and walking or crawling on the wrist or ankle-joints. They snap or snarl at one, and both in the look of their face and eye, and by their growl, put one in mind of hyænas. The teeth are very rudimentary. They feed on white ants and carrion. Sparrman first published an account of it in 1786, and Professor Flower has given a description of a fully adult male, with a beautiful illustration, in the "Proceedings of the Zoological Society" for 1869.



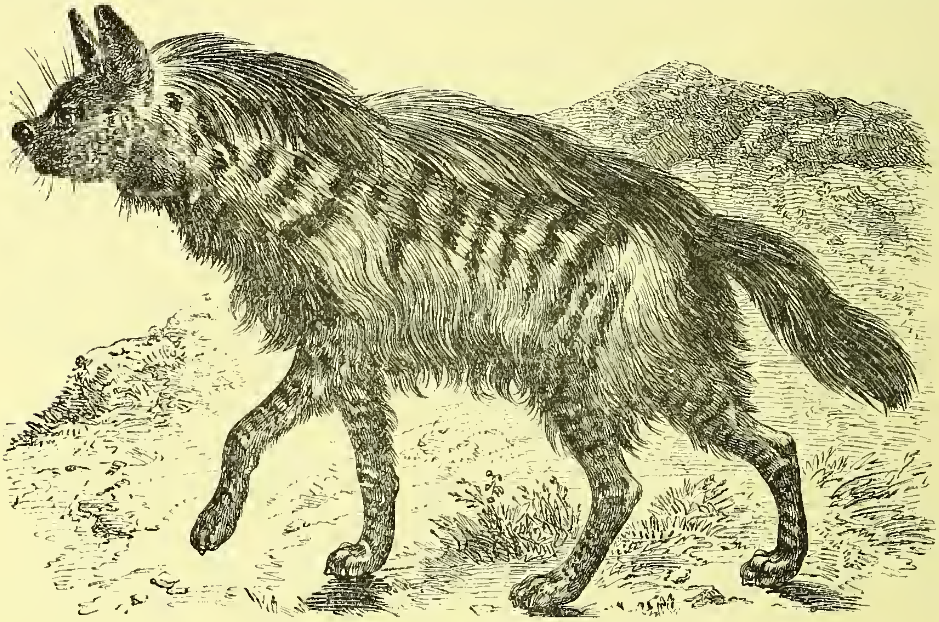
THE AARD WOLF (*Proteles lalandii*).

FAMILY XXVIII.—HYÆNIDÆ.

In this family we find but a single genus, Hyæna, and three species. All three are found in Africa; but one species, H. striata, is found to extend from Barbary to Egypt, into Arabia, Persia, and the neighbouring Asiatic countries. In the Hyænas the teeth are large and well developed. The tubercular grinders are single only in the upper jaw.

The Striped Hyæna (*H. striata*). The Hyæna feeds principally at night, and conceals himself during the day in his den, among ruins, craggy rocks, or solitary thickets. As evening draws in, these animals begin to prowl, haunting the streets of villages and towns, where they devour the offal, not refusing the hardest bones, which they crush into small fragments with their powerful jaws. The hyæna does not, however, confine his visits to towns and villages, nor his food to the offal there. He also roams round the country in packs, in search of living prey.

Bruce says:—"The hyænas were the scourge of Abyssinia in every situation, both of the city and the field; and they seemed to surpass even the sheep in number. From evening till the dawn of day the town of Gondar was full of them: here they sought the different pieces of slaughtered carcases which were exposed in the streets without burial. Many a time in the night, when the king had kept me late in the palace, on going across the square from the king's house, I have been apprehensive lest they should bite me in the leg. They grunted in great numbers around me, although I was surrounded with several armed men, who seldom passed a night without wounding or slaughtering some of them. One night I went out of my tent, and returning immediately, I saw two large blue eyes glaring at me in the dark. I called my servant to bring a light, and we found a hyæna standing near the head of the bed with two or three large bunches of candles in his mouth, by keeping which he seemed at that time to wish for no other prey. I was not afraid of him, and, with a pike, struck him as near the heart as I could. It was not till I had done this that he showed any signs of fierceness; but, upon feeling his wound, he dropped the candles, and endeavoured to run upon the shaft of the spear to arrive at me; so that I was obliged to draw a pistol from my girdle and shoot him; and nearly at the same time my servant cleft his skull with a battle-axe. In a word, the hyænas were the plague of our lives, the terror of our night-walks, and the destruction of our mules and asses, which are their favourite food."



THE STRIPED HYÆNA (*Hyæna striata*).

The Spotted Hyæna (*H. crocuta*) is confined to South Africa. Mr. Shepstone, in a letter from Mamboland, relates that their nightly attacks have been very destructive among the children and youth; for, within a few months, not fewer than forty instances came to his knowledge in which they had made a most dreadful havoc. "To show clearly," says that gentleman, "the preference of this animal for human flesh, it will be necessary to notice that when the Mambookies build their houses, which are in form like beehives, and tolerably large, often eighteen or twenty feet in diameter, the floor is raised at the higher or back part of the house, until within three or four feet of the front, where it suddenly terminates, leaving an area from thence to the wall, in which every night the calves are tied, to protect them from the storms, or from the wild beasts. Now, it would be natural to suppose that, should the hyæna enter, he would seize the first object for his prey, especially as the natives always lie with the fire at their feet; but, notwithstanding this, the constant practice of this animal has been to pass by the calves in the area, and even by the fire, and to take the children from under the mother's kaross; and this in such a gentle and cautious manner, that the poor parent has been unconscious of her loss until the cries of her little innocent have reached her from without, when it has been a close prisoner in the jaws of the monster." The size of the hyæna is that of a large mastiff; but the head and neck are of great thickness, and possess tremendous strength. In combat, he fears no animal, and will even resist the lion. His coat consists of long, harsh hairs, which form a mane running down the back from the shoulders; the colour is a dirty grey, spotted. The hyæna stands higher before than at his hind-quarters—his hind legs, indeed, seem bowed and proportionally weak; hence his walk is a shuffling, awkward pace, and yet he can run with great celerity. Like the dog, he is impatient of confinement. This and ill usage combine to break his temper, and render him distrustful and savage.

The Brown Hyæna (*H. brunnea*) is also a South African species.

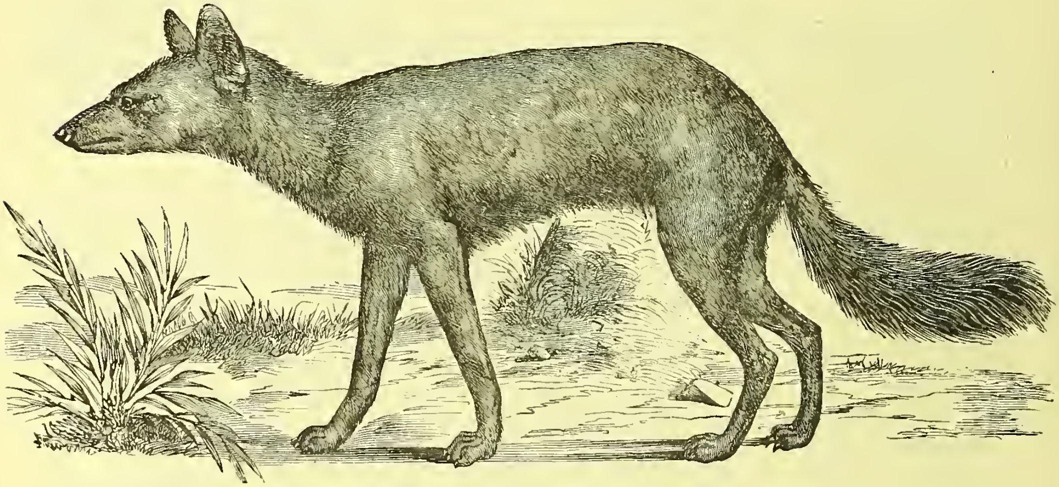
FAMILY XXIX.—THE DOGS (*Canidæ*).

The animals belonging to this family are well known as Wolves, Dogs, and Foxes, and these constitute rather natural divisions of this family. The wolves have a short and straight tail; the dogs a more or less elongated tail, bent to the left and more or less curled; while the foxes have elongated bushy tails. Some authors make a large number of genera to contain the fifty to sixty species belonging to this family; here we will content ourselves with grouping them into ten genera or sub-genera.

The Hyæna Dog (*Lycaon pictus*) is found at the Cape of Good Hope and along parts of the east coast of Africa. This is sometimes called the Cape hunting dog, and is occasionally to be seen living in the London Zoological Gardens. Cuvier says that "while dog-like, it is certainly not a dog," but Dr. Crisp says that, "looking to its ribs, teeth, and alimentary canal, it is more nearly allied to the dogs." A pair were living in the London Zoological Gardens in 1855. The dog died of some disease of the brain. After his death the bitch refused her food, became restless, howled frequently, and died without apparently any morbid lesion within ten days. Icticyon venaticus is a wolf-like dog found in Brazil.

The genus Cuon contains four species of wild dog found occurring from the Altai Mountains in Siberia to Java. The wild dog of Nepaul (*Cuon primævus*) is thus described by Mr. Hodgson:—"The Búánsú, or wild dog of the Nepaulese, inhabits that part of these mountains which is equidistant from the snows and the plains, or, in other words, the middle region of Nepaul. But he frequently wanders into the southern division, and sometimes into the northern. His limits, east and west, are, as I know, the Kali and Tista; and, as I am informed upon good authority, the Sutlej and the Brahmapootra. Wild dogs, probably not materially differing from those of Nepaul, are found likewise in the Vindhya, the Gháts, the Nilgaris, the Kasya Hills, and finally in the chain extending brokenly from Mirzapur through South Behar and Orissa to the Coromandel Coast. The Búánsú is, in size, midway between the wolf and the jackal, being two feet and a half long from the tip of the nose to the insertion of the tail, and twenty-one inches in average height. It is a slouching, uncompact, long, lank animal, with all the marks of uncultivation about it, best assimilated in its general aspect to the jackal, but with a something inexpressibly, but genuinely, canine in its physiognomy. It has a broad flat head and sharp visage, large erect ears, a chest not broad nor deep, a shallow compressed barrel, somewhat strained at the loins, long heavy limbs, broad spreading feet, and a very bushy tail of moderate length, straight and carried low. Its colour is deep rusty red above, yellowish below. It stands rather lower before than behind, with the neck in the line of the body, the head unelevated, and the nose pointed almost directly forwards, the fore limbs straightened, the hind stooping, the back inclined to arch, especially over the croup, and the tail pendulous. In action the tail is slightly raised, but never so high as the horizontal line. Though the Búánsú be not deficient in speed or power of leaping, yet his motions all seem to be heavy, owing to their measured uniformity. The fur, or external covering of the Búánsú, consists of wavy wool and straight harsh hair—in summer in nearly equal proportions, in winter, two parts of wool to one of hair. The tail towards its base is ringed with pale rusty and blackish; towards its tip the hairs are almost or wholly blackish.

The wild dog preys by night and by day, but chiefly by day. Six, eight, or ten unite to hunt down their victim, maintaining the chase by their powers of smell rather than by the eye. They usually overcome their quarry by dint of force and perseverance, though they sometimes effect their object by mixing stratagem with direct violence. In hunting they bark like hounds, but their barking is in such a voice as no language can express. It is utterly unlike the fine voice of our cultivated breeds, and almost as unlike to the peculiar strains of the jackal, and of the fox. The Búánsú does not burrow like the wolf and fox, but reposes and breeds in the recesses and natural cavities of rocks, in the manner of the jackal of Nepaul. There is scarcely a wild animal, however large or formidable, which the wild dogs will not sometimes attack and destroy; and tame buffaloes and cows, when grazing in very solitary districts, sometimes fall a sacrifice to their ravenous appetite. Human beings they are never known to attack, and, indeed, they seem to be actuated by a very peculiar degree of dread of man. Those which I kept in confinement, when their den was approached, rushed into the remotest corner of it, huddled one upon another, with their heads concealed as much as possible. I never dared to lay hands on them, but if poked with a stick they would retreat from it as long as they could, and then crush themselves into a corner, growling low, and sometimes, but rarely, seizing the stick and biting it with vehemence. After ten months' confinement, they were as wild and shy as the first hour I got them. Their eyes emitted a strong light in the dark, and their bodies had the peculiar fœtid odour of the fox and jackal in all its rankness. They were very silent, never uttering an audible sound save when fed, at which time they would snarl in a subdued tone at each other, but never fight; nor did they on any occasion show any signs of quarrelsomeness or pugnacity."



THE HYÆNA DOG (*Lycaon pictus*).

Dr. Murie would regard it as the only species, and having geographically say four varieties.

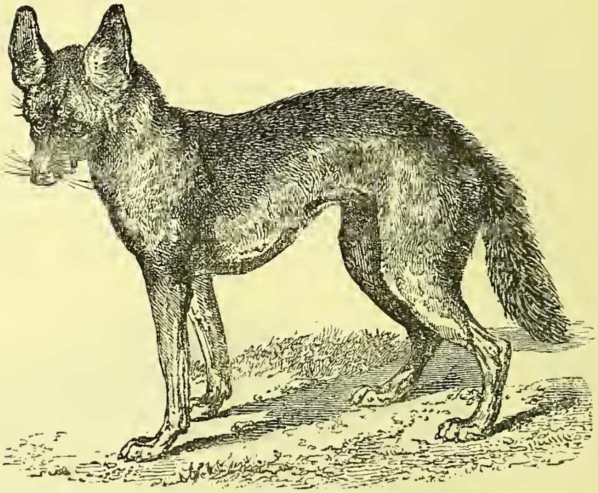
Under the genus Lupus we place the wolves and jackals. The European Wolf (*L. vulgaris*) is now scarcely met with in Western Europe, being only rarely met with in France or Spain. It was found in Scotland until 1680, and in Ireland until about 1710. A black variety is met with in some of the mountains of Spain and France. The sense of smelling possessed by the wolf is peculiarly strong. He can wind his prey from a very considerable distance. He runs the foot of the animal he is in pursuit of in the same manner as a dog. His track much resembles that of a dog, but it is longer and broader. The two middle claws are near together; the outer ones somewhat wider apart; the ball of his foot is large, and of the shape of a heart. When the animal is walking, he places his hind foot on the track of his fore foot; when trotting, three or four inches in advance of it. If there be several wolves, they often follow on each other's track, so that it is not easy to distinguish their numbers.

The average height of the common wolf is about two feet six inches before, and two feet four inches behind; and the length of the body, from the tip of the muzzle to the beginning of the tail, three feet eight inches. The cubs of the wolf are born with their eyes shut. The female has eight or nine at a litter. After their eyes are open the male joins her in the care of rearing the young, and in bringing partridges, moor-fowls, rats, and moles to the lair. With the growth of her progeny the she-wolf becomes more vigilant and daring. She conducts them to the nearest sequestered water two or three times a day, that they may drink. As they increase in stature, both parents take them out to hunt. The average duration of life is from fifteen to twenty years.

The American Wolf (*L. occidentalis*). Sir John Richardson states that the American wolf burrows, and brings forth its young in earths with several outlets, like those of a fox. He saw some of their burrows on the plains of the Saskatchewan, and also on the banks of the Coppermine River. The number in a litter he states to vary from four or five to eight or nine. After referring the instances recorded by Parry and Franklin of the association of the female wolves with the domestic dog, he relates that he was informed that the Indians endeavour to improve their sledge-dogs by crossing the breed with wolves, and he adds, that the resemblance between the northern wolves and the domestic dog of the Indians is so great, that the size and strength of the wolf seems to be the only difference. "I have more than once," he says, "mistaken a band of wolves for the dogs of a party of Indians; and the howl of the animals of both species is prolonged so exactly in the same key, that even the practised ear of an Indian fails, at times, to discriminate them."

THE WOLF (*Lupus vulgaris*).

An Esquimaux wolf-trap is made of strong slabs of ice, long and narrow, so that a fox can with difficulty turn himself in it, but a wolf must actually remain in the position in which he is taken. The door is a heavy portcullis of ice, sliding in two well-secured grooves of the same substance, and is kept up by a line, which, passing over the top of the trap, is carried through a hole at the furthest extremity; to the end of the line is fastened a small hoop of whalebone, and to this any kind of flesh-bait is attached. From the slab which terminates the trap, a projection of ice, or a peg of wood or bone, points inwards, near the bottom, and under this the hoop is lightly hooked. The slightest pull at the bait liberates it, the door falls in an instant, and the wolf is speared where he lies. Well-marked varieties of this species occur throughout America; a black variety is found in Florida and Georgia; a red variety is met with in Texas; and in Mexico the fur is varied with grey and black.



THE JACKAL (*Lupus aureus*).

The Jackal (*L. aureus*) is found in Europe (Southern Russia and Greece), in Syria, Persia, and the entire of India westward of Brahmapootra. The shriek of this animal has often been said to be more terrific than the howl of the hyæna or the roar of the tiger, and it is probably most alarming, from its singular dreariness, amidst the lonely regions in which it is heard. Captain Beechey says, "It has something in it rather appalling when heard for the first time at night; and, as they usually come in packs, the first shriek which is uttered is always the signal for a general chorus.

The jackals form burrows in the earth, assemble together in numerous troops, and have an offensive odour. They follow the footsteps of the greater feline animals, such as the lion and the tiger, for the sake, as some suppose, of securing the remnants of their prey; but, assuredly, so far from providing for the king of beasts, it is believed that they often do all in their power to circumvent and disappoint him. In regard, at least, to the tiger, it is well known in India, that, while on ordinary occasions the nocturnal cry of a jackal is responded to by all his companions around, till the leafy woods become as the howling wilderness, there is a peculiar note of warning uttered by one of these creatures on the approach of the tiger, which sinks the voices of all the others into the profoundest silence.

In America the jackal is replaced by the Prairie Wolf (*Chryocyon latrans*). According to Sir John Richardson, this species occupies the high sandy plains between the sources of the Saskatchewan and the Missouri. They burrow like foxes, and come out of their holes, assembling round the hunter, on the first report of a gun, with evident hopes of sharing in the spoils of his sport. They are exceedingly swift of foot, assemble in great numbers, hunt in large packs, and have a barking voice.

DOGS OF CONSTANTINOPLE.

In a specimen seen by Colonel Hamilton Smith, the form of the head, the muzzle, the nose, and position of the eyes, greatly resembled the northern shepherd's dog. The fur was entirely of an ashy grey, but there was some white about the breast and on the end of the tail, which was more bushy than in the common wolf.

Of the dogs belonging to the genus Canis, a whole volume might be written. Almost wherever the world is inhabited by man there is to be found the dog (*C. familiaris*). Varieties of the dog have existed from the very remotest times. Many of these are only kept true by most careful breeding. Some varieties can only be regarded as malformations, such as the bull-dog, with a broken nose; the pug, with a short imperfect upper jaw; and the mastiffs, with long and very pendulous lips. Again, in the dogs of Japan there is a protuberance of the eyes, so great that the bony orbit is little of a protection. In many countries dogs are allowed to go wild, and the stranger visiting Cairo, Alexandria, or Pera for the first time, will be startled by the flocks of these animals that he will meet with. The following account of the dogs of Constantinople is extracted from the letter of the special correspondent of the *Times* of January 7th, 1876:—"Who would keep an account of the dogs—of those omnipresent, lawless, yet perfectly harmless dogs—which are both no man's and every man's property? And yet, as I walk along the Pera or Stamboul streets, and can hardly help treading upon them lying everywhere in my way, I am not quite sure that I do not deem them an object of as great an interest as many of the turbaned bipeds who shrink from the unclean animal as they do from the Giaour. It is to me a matter of doubt whether the dogs are not here indigenous to the soil; older inhabitants than either Byzantine, Frank, or Osmanli, all races which designate each other as 'dogs,' and none of which are half as kindly disposed towards each other as they are to the dogs or those to them. I am told that a drop of jackal blood runs throughout all the breed of the canine population of Turkey; but whatever may be their remote origin, these animals are here, with few exceptions, no mongrels. In shape, in countenance, in language, in their bandy legs, pointed noses, prick-up ears, dirty yellow coats, and bushy tails, they could be hunted as foxes in Gloucestershire. Perfectly inoffensive as they are while living, the dogs do not cumber the earth when dead. What becomes of their carcases I cannot tell, but although dead cats are an ordinary sight enough in the Pera thoroughfares, I am convinced that it is here as useless to look for a dead dog as for a dead donkey in England. And yet at certain hours of the day one would say that there are none but dead dogs to be met with in the place. They are up and doing from sunset to sunrise, and enjoy the refreshment of well-earned, profound sleep almost throughout the day. They are not only masterless and homeless, but have also a sovereign contempt for bed or shelter. There is a time, it would seem, when sleep comes upon them—all of them—like sudden death; when all squat down, coil themselves up, nose to tail, wherever they chance to be—on the footpath, in the carriage-way, in the gutter—and there lie in the sunshine, in the pelting rain, yellow bundles hardly distinguishable from the mud. The Constantinople dog never learns to wag his tail; he never makes up, never looks up, to a human being, never en-

THE MASTIFF.

THE NEWFOUNDLAND DOG.

courages or even notices men's advances. He is not exactly sullen, or cowed, or mistrustful; he is simply cold and distant, as an Englishman is said to be when not introduced. On Fridays, as we learn from the handbooks, there are distributions of bread and dogs' meat throughout Islam, and a dole of dogs' bread and biscuit at the Bayezidyeh, or Bayazet's mosque. But your Turkish dog has an independent spirit. He prefers catering for himself; he prowls about all night; he picks up what he can get out of the garbage which is laid out at every street-door, and performs, as a scavenger, a service of far greater benefit to the community than of emolument to himself.'

THE FOX (*Vulpes vulgaris*).

Of our well-known varieties we may mention, following Colonel Smith:—1. The Wolf dogs, densely clothed with long hair, inhabiting the Northern regions, large, sagacious, and laborious: the Siberian, Esquimaux, Iceland, and Newfoundland dogs, the Sheep and the Wolf dogs, the St. Bernard and the Pomeranian. 2. The Watch dogs, with fur short, an instinct for watching, bold, with only moderate sagacity: the Danish dog, the Bearhound, and the dog of the North American Indians. 3. The Greyhound, stature high, chest deep, loins arched, tail slender; ears small, pointed, mostly turned back; little power of scent, little sagacity or personal attachment, great swiftness, and hunt by sight: those with long fur—the Persian, Russian, Tartar, Grecian, Scotch, and Irish hound; those with short fur—the British, Italian, and Egyptian Greyhounds. The dogs of the East would come in here as mongrels. 4. The Hounds, with large broad skulls, great powers of smell, sound pendulous ears, great sagacity, tending of tail to turn up, fur white and black or spotted: with short fur—the Blood, Stag, and Foxhound, the Harrier, Beagle, Turnspit, Coach-dog, and Pointer; with long fur—the Setter, the Spaniel, the

Cocker, the Blenheim, King Charles, Maltese, Poodle, and Barbet. 5. The Terriers, with round heads, muzzle pointed, eyes large, prominent, ears erect, of small size, sagacious, watchful, noisy. 6. The Mastiffs, with strong legs, neck and loins strong, tail carried erect: the English, Cuba, and Thibet Mastiffs; the Bull-dog. Here would come the Bull-terrier and the Pug.

The species of the genus Lycalopex and the closely related genera Pseudalopex and Thous are to be met with only in South America. They are often called the Fox-tailed Wolves, having a wolf-like form, but long, hairy, fox-like tails. L. vetulus is found in Brazil. P. azaroe is mentioned by Mr. Darwin as occurring in Patagonia. P. antarctica is met with on the Falkland Islands. The Crab-eating dog (*Thous cancrivorous*) is found in French Guiana hunting in small packs.

The Common Fox (*Vulpes vulgaris*) is the type of a well-marked division of the dogs. In the foxes the tail reaches to the ground, and ends in an abundance of soft hairs, which form a brush. They are shy, cautious, exceedingly cunning and patient, cleanly, and retired. Whilst young, they are full of vivacity and playfulness. Their resources of instinct to escape detection or an enemy are numerous, never trusting to their courage until they are exhausted, and then defending themselves to the last gasp against dogs.

As the dusk of the evening advances, the fox generally steals from his burrow, with noiseless steps, to prowl about for prey. With senses of smell and hearing extremely keen he listens and sniffs the breeze. Alive to every sound and odour, his eyes gleam, as he creeps along in a crouching attitude. Stealthy in all his movements, he surprises the rabbit gamboling near

THE FENNEC FOX (*Feneca zaarensis*)

its burrow, the hare on her form, and the poultry on their perch. He slaughters all he can, and buries the overplus in the earth, for future exigency. Field-mice, frogs, weasels, insects, and ripe grapes are devoured in times of scarcity. The voice of the fox is a sort of yelp, which, however, it never exerts when creeping about, or watching the movements of its prey. Solitary in his habits, the fox dwells alone in a burrow, which he has either made or usurped. It is generally in some secluded situation, not readily discovered, and in the neighbourhood of farms, a rabbit-warren, or preserves of game. The speed of the fox and his powers of endurance have recommended him in our country to lovers of the chase, for whose gratification the breed is preserved.

When hunted, they make a direct effort to gain the earth, and, if this be stopped, they make a circuit and then return to the same, or to a second outlet; but, when convinced their home is closed up, they start off for some distant cover with great velocity, leaving a strong scent. Hounds hunt them with apparent pleasure, and are often tried to the utmost before they can defeat the wiles of their prey.

The Tahaleb, or Egyptian Fox (*V. niloticus*), is met in North Africa. The Kit Fox (*V. velox*) is found in North America. Seventeen species are enumerated in Dr. J. E. Gray's catalogue, and they are to be met with over all the great continents, with the exception of South America and Australia. The Red Fox of North America (*V. fulvus*) has long, soft, and silky hair, for which it is yearly killed in great numbers, thousands of their skins being imported into England every year. They are generally caught in traps. A beautiful variety of this fox is often met, in which the fur is entirely black, except on the posterior part of the back, where the hairs are ringed with silver-grey. The skin of this variety, called the Silver Fox, brings a very high price in the European markets.

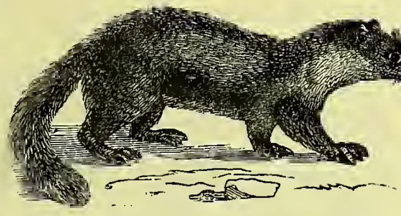
THE ARCTIC FOX (*Leucocyon lagopus*).

The Fennecs are a little group of foxes with long hair and spreading ears, to be met with in Africa. The common Fennec (*Feneca zaarensis*) of North Africa is small, and slightly made, with slender limbs. The length of the head and body is about thirteen inches, that of the tail eight. The fur of the body is rather short, but full and silky. The colour is uniform pale fawn, or cream-colour, passing into white beneath; the inside of the ear is fringed with long white hairs; the whiskers are white. In the districts of Benni Mezzab and Werglah, where the date grows, the Fennecs are hunted for their skins, for which, according to Bruce, who first made us acquainted with this elegant animal, there is a market at Mecca, whence they are exported to India.

A fennec in his possession, while he was at Algiers, was fond of dates, or any sweet fruit, and was also partial to eggs. He would eat bread when hungry, especially when sweetened with honey or sugar. The sight of a bird aroused him to eager watchfulness as long as it was present. He would endeavour to hide from a cat, and never showed a disposition to resist or defend himself. He was disposed to sleep by day, but as night came on was excessively restless. He was never heard to utter any sound.

Bruce says that the animal is described in many Arabian books under the name of El Fennec, by which appellation, he states, it is known all over Africa.

The Arctic Fox (*Leucocyon lagopus*) is of a fine white colour in the adult state. It is, according to Captain James Ross, found in the highest northern latitudes throughout the winter. The young generally migrate to the southward late in the autumn, and collect in vast multitudes on the shores of Hudson's Bay. They return early the following spring along the sea-coast to the northward, and seldom again leave the spot they select as a breeding-place. Their southern limit in North America appears to be about 50° N. latitude. They are numerous on the shores of Hudson's Bay, north of Churchill, and are found at Behring's Straits; but the brown varieties are the more common in the latter quarter. This animal is gregarious, forming burrows in sandy spots, twenty or thirty together. Sir John Richardson saw one of these fox-villages on Point Turnagain, in 68½° N. latitude. It soon becomes tame in confinement, and is eager to hide its food as soon as it is obtained, even when there seems no danger of losing it. Snow is the material generally used for this purpose, and, when piled over the food, it is forcibly pressed down by the nose.



THE PINE MARTEN (*Martes abietum*).

The Grey Fox (*Urocyon virginianus*) has a long tail, covered with long soft hairs, but with a crest of stiff hair, forming a tuft, which is unmixed with, though covered by, the softer hair. It is found throughout North America.

The Raccoon Dog (*Nyctereutes procyonoides*) has a short, bushy tail, and is found in Japan, the Amoorland, to Canton.

The last species of this family that need be mentioned is the Long-eared Fox of South Africa (*Otocyon Lalandii*). The dentition is unlike that of the dogs. The tail is short, straight, bushy, not reaching beyond the knees.

FAMILY XXX.—MUSTELIDÆ.

This family contains nearly double the number of species as the last. They are found over the whole world, with the exception of Australia, and it may be divided into the three sub-families of the Weasels, Otters, and Badgers.

Sub-Family 1.—Mustelinæ.

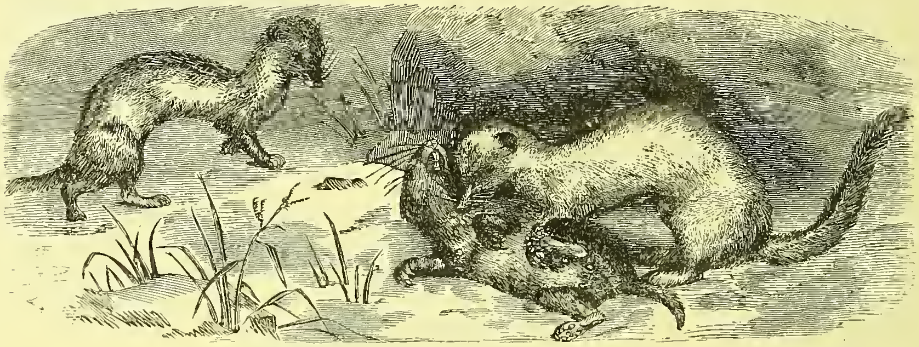
In this group the head is oblong, the toes are slightly webbed. The tail is cylindrical, in some slender, in others bushy. The soles of the hind feet are hairy, with four bald places, or pads, in front. Dr. Gray makes eight genera. The first of these contains the Martens.

The Pine Marten (*Martes abietum*) is still, but rarely, met with in Scotland and Ireland. It is found over Europe, and in Siberia.

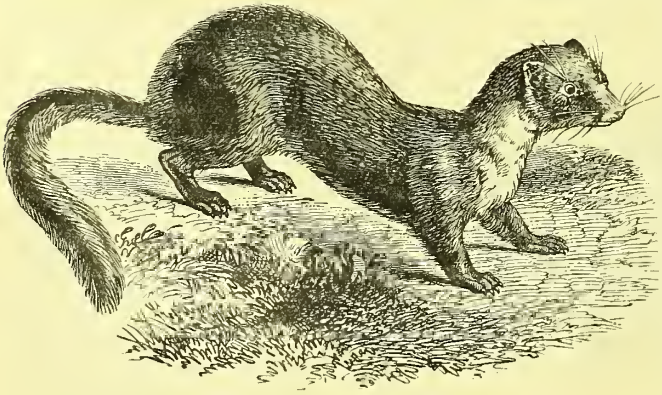
THE POLECAT (*Putorius fœtidus*).

The Sable (*M. zibellina*) is a native of northern Europe and Asia. The fur of this animal is very soft, of a black, grey, or yellow-brown colour. There are, however, a great many varieties of colouring, from an almost pure black to a nearly pure white. The latter is met with in Siberia. The price of a skin varies according to the age and condition of the animal—from £1 to £8.

The American Sable (*M. Americana*) would appear to be a distinct species. M. Brandt says he can see no appreciable difference between them, while Dr. Baird insists on their being different. Dr. Gray finds a difference in their dentition. The fur of this animal is also highly prized, and an article of extensive commerce. The animal is found in the immense forests of North America, where it lives like a squirrel among the trees, which it climbs with the utmost facility. It is said to usurp the nest of a squirrel, or bird, the original possessor of which has fallen a victim to its rapacity; and in this homestead, which another's labours have founded, the female rears her young. The general colour of the fur, which consists, as is usual, of two sorts of hair, is a deep chestnut, except on the throat and margin of the ears, where the chestnut colour abruptly gives place to a fine yellow. In summer the tints not only become lighter, but the fur shorter; and the toes, which during the winter were well protected with woolly hair, are deprived of their covering, and the claws are completely exposed.


ERMINE AND WEASEL (*Mustela erminea and vulgaris*).

According to Sir John Richardson, the American Sable inhabits the woody districts in the northern parts of America, from the Atlantic to the Pacific, and it has been observed to be especially abundant where the trees have been killed by fire, but are still standing. Particular races, distinguished by the fineness and dark colour of their fur, appear to inhabit certain rocky districts. The rocky and mountainous but woody district of the Nipigon, on the north side of Lake Superior, has long been noted for its black and valuable skins. The importation of them from the territories of the Hudson's Bay Company and Canada is great. Upwards of 100,000 skins have long been annually imported into Great Britain. The sable preys on birds' eggs, mice, hares, and partridges. It often destroys the hoards of meat and fish laid up by the natives, when they have accidentally left a crevice by which it can enter. When its retreat is cut off, it shows its teeth, sets up its hair, and hisses like a cat. It will seize a dog by the nose, and bite so hard that, unless the latter is well used to the combat, it escapes. It is easily tamed, and becomes attached to its master, but is not docile.


THE WHITE-BREASTED MARTEN (*Mustela foina*).

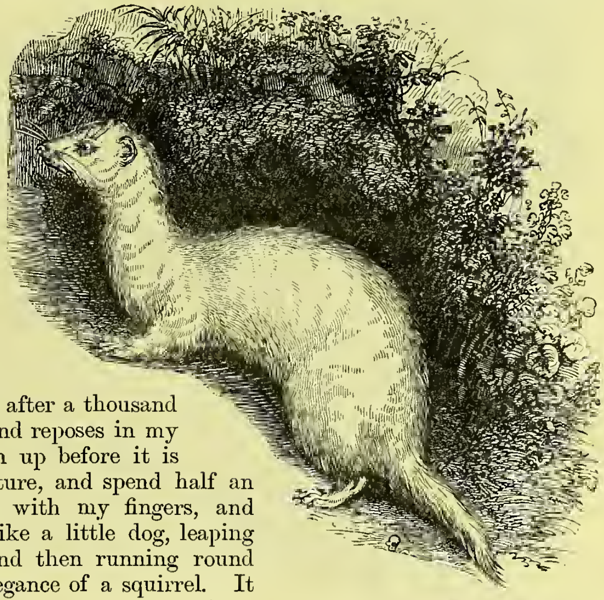
The common White-breasted Marten (*M. foina*) is not uncommon in the British Islands, and is found all over Western Europe, and, as we have mentioned, is considered by Rolleston to have been the γαλῆ of the classics.

The Polecat (*Putorius fœtidus*) is rare in England and Scotland, though not uncommon in the temperate regions of Europe. This animal, in the neighbourhood of a farmyard, is as mischievous as a fox, and even more so. Whole broods of chickens are often destroyed by it during a single night, and the bodies left on the spot.

The Ermine or Stoat (*Mustela erminea*) is not uncommon in Great Britain, but except in the alpine parts of Scotland, it never becomes white in winter. It may be said to inhabit the whole of Northern Europe, North Africa, where the tail becomes short, and North America. Some zoologists separate the Ermines of America from those of Europe.

The Weasel (*M. vulgaris*) has very much the same geographical distribution as the Stoat, being found in Great Britain, the North of Europe, Asia and America. The length of this animal, exclusive of the tail, is about seven inches, and its height not above two and a half. The colour of its upper parts is a pale reddish-brown, and its breast and belly are white; but on each side, below the corners of the mouth, is a brown spot. The ears are small and rounded, and the eyes black. The weasel breeds two or three times in a year, having a litter of five at each birth. She makes her nest of dried herbage; a hole in a bank side, among brambles, or in an old tree, is the usual place of her retreat; and when molested she defends herself and her progeny with indomitable courage.

Although Buffon was of opinion that the weasel was an animal incapable of domestication, we have the following interesting account of one in a letter of Mademoiselle de Laistre:—"If I pour some milk into my hand," says she, "it will drink a good deal; but if I do not pay it this compliment it will scarcely take a drop. When it is satisfied it generally goes to sleep. My chamber is the place of its residence; and I have found a method of dispelling its strong odours by perfumes. During the day it sleeps inside a quilt, entering by a place that is unsewed in its edge, which it accidently discovered. At night I keep it in a wired cage, which it always enters with much reluctance, but leaves with joy. If the servant sets it at liberty before I am up in the morning, after a thousand gambols, it comes into my bed, and reposes in my hand, or on my bosom. If I am up before it is let out, it will fly to me in rapture, and spend half an hour in caressing me, playing with my fingers, and nibbling at them with its teeth like a little dog, leaping on my head and on my neck, and then running round my arm with the softness and elegance of a squirrel. It seems at all times exceedingly desirous of being noticed, watching my eye during all its little pranks, to see if I observe it. If I am inattentive to its sports it seems to have no pleasure in them, immediately desists, and lays itself down to repose. This little creature can distinguish my voice amid twenty others, and springs over every one in the room till it has found me. Nothing can exceed the lively and pleasing way it caresses me with its two little paws; it frequently pats me on the chin, in a manner that expresses the utmost fondness. The curiosity of this little pet is unbounded, for it is impossible to open a drawer or box without its roving through every part of them; if even a piece of paper or a book is looked at, it will also examine it with attention. Everything I take into my hand it must run up to, and survey with an attentive scrutiny. I have a young dog and cat, with both of which it is very familiar; it will scamper over their necks, backs, and legs, without their offering it the smallest injury."


THE FERRET (*Mustela furo*).

The Ferret (*M. furo*) is a native of Africa. It is known in this country as half-domesticated. A Black-faced Weasel (*M. brasiliensis*) is met with in Brazil, Mexico, and as far north-east as California.

Of the genus Vison, Dr. Gray mentions six species. The American Vison (*V. lutreocephala*) yields a useful fur, known to the fur trades as minx or mink. V. lutreola is found all through the north and east of Europe, and from the Tay to the Black Sea.

The four species of the genus Gymnopus are found in Africa, Sikkim, Nepaul, and Borneo.

The Glutton (*Gulo luscus*) is found in all the countries washed by the North Sea. Pallas says it is rare in Russia, except in the great forests of the very north, where it extends beyond Siberia. It comes as far south in America as the Great Lakes. The glutton is so suspicious, that it will rarely enter a trap; but, beginning behind, will pull it to pieces, scatter the logs upon which it is built, and then carry off the bait. It feeds on meadow-mice, marmots, and other rodents, and occasionally, it is said, even on elks and reindeer, springing upon them from trees. Sir John Richardson has seen one chasing an American hare, which was at the same time harassed by a snowy owl. The glutton resembles the bear in its gait, and is not fleet, but it is very industrious, and no doubt feeds well, as it is generally fat. It is much abroad in the winter, and the track of its journey in a single night may be often traced for many miles. From the shortness of its legs, it makes its way through loose snow with difficulty; but when it falls on the beaten track of a marten-trapper it will pursue it for a long way. Sir James Ross thus describes an incident that occurred in Victoria harbour:—"In the middle of the winter, two or three months before we abandoned the ship, we were one day surprised by a visit from a glutton, which, pressed hard by hunger, had climbed the snow-wall that surrounded our vessel, and came boldly upon deck, where our crew were walking for exercise. Undismayed at the presence of twelve or fourteen men, he seized upon a canister which had some meat in it, and was in so ravenous a state, that whilst busily engaged at his feast he suffered me to pass a noose over his head, by which he was immediately secured and strangled."

THE GLUTTON, OR WOLVERINE (*Gulo luscus*).

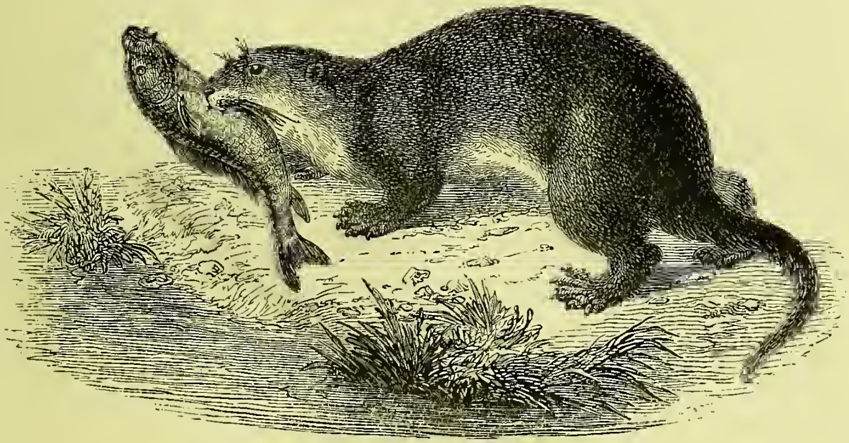
The glutton produces young once a year, in number from two to four. The cubs are covered with a downy fur of a pale cream-colour. Pennant says that the skin is sold in Siberia for four or six shillings; at Yakutsk, for twelve shillings; and still dearer in Kamtchatka, where the women dress their hair with its white paws, which they reckon a great ornament. The fur, he adds, is greatly esteemed in Europe; and he remarks that the skins of the glutton of the north of Europe and Asia, which are sometimes to be seen in the furriers' shops, are infinitely finer, blacker, and more glossy than those from America. Sir John Richardson says that the fur of the American glutton bears a great similarity to that of the black bear, but is not so long, nor of so much value.

SUB-FAMILY 2.—LUTRINÆ.

The animals belonging to this sub-family are known as Otters. They are aquatic, have the toes webbed; the tail is thick, tapering, and depressed. Although Dr. Gray establishes eight genera, we are inclined here to follow Carus in admitting but three—Lutra, Pteronura, and Enhydris; perhaps Aonyx might be added.

Lutra barang was first found in Sumatra, but it is also met with in Borneo.

The Common Otter (*L. vulgaris*) is met with all over Europe, and is not rare in the British Islands. It is admirably adapted to its aquatic habits. Its body is long and flexible, and terminated by a lengthened, robust, but tapering and somewhat compressed tail, which serves as a sort of rudder in the performance of the evolutions of the animal in the water. The limbs are very short, but remarkably muscular and powerful; and the feet, which consist of five toes each, are webbed, so as to serve as paddles or oars. The eyes are large, the ears short, and the lips are provided with strong whiskers. The covering consists of two kinds of fur—an under-vest of close, short fur, and an outer-vest of long, coarse glossy hairs. Shy and recluse, the otter is nocturnal in its habits. lurking by day in its burrow, which opens near the water's edge, concealed among intertangled herbage, and is generally carried to a great depth in the bank. Here, on a bed of leaves and grass, the female brings forth and rears her young, attending to their wants with great assiduity, and exhibiting for them a remarkable share of maternal solicitude. She produces four or five young at a birth, in May or June.



THE OTTER (*Lutra vulgaris*).

The otter is found still on the sea-shores of the western islands of Scotland; and it has long been a favourite sport among the Highlanders to hunt it with dogs of the terrier breed. In our day, otter-hunting is far less commonly practised than it used to be, as the animal is more scarce, as well as more limited in its localities; it is not, however, by any means forgotten. So far from being confined to fresh-water rivers, the common otter is known to frequent the sea in the north of Scotland, and to hunt far out. In Cornwall, the otter will go a mile from the shore in the summer and good weather after its prey. On the sea-shore, rocky coves, with scattered blocks, hollows, and cavities under large stones, are his haunts.

L. chilensis has been taken in the sea of Chili, at California, and Kamtchatka; L. maculicollis is found in South Africa, and L. canadensis is common in North America.

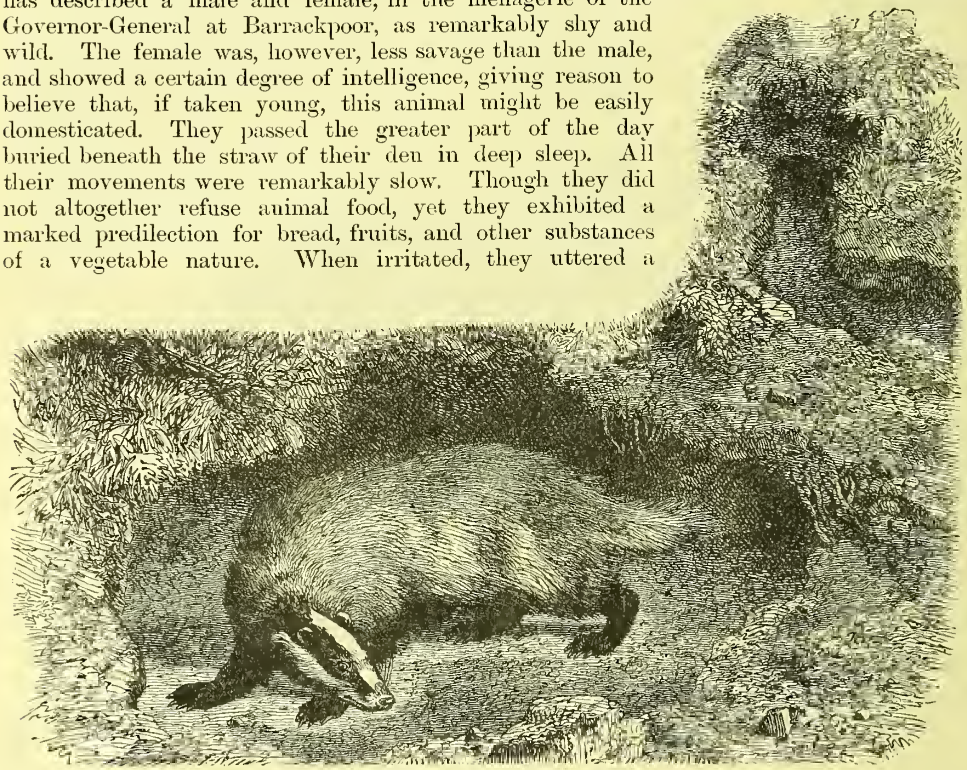
The species of the genus Aonyx have the index and middle finger united together to the third joint; the claws are obsolete, or rudimentary and short. A. lalandii is met with in rivers and lakes in South Africa, and as far up the eastern coast as Mozambique; A. leptonyx in Java, Sumatra, and Borneo; and A. indigitata in the Nepaul Hills and Serai.

Pteronura sandbachii is a remarkable otter from Demerara and Surinam, which is quite different from the Sea Otter of California (*Enhydris lutris*). In this latter species the hind feet are large, elongated, rather fin-like, hairy above and below; the outer toes largest; claws small; the tail is short and cylindrical. This species was noticed, and figures of it given, in "Captain Cook's Second Voyage."

SUB-FAMILY 3.—MELININÆ.

In this sub-family we have the Badgers, Ratels, and Skunks. Though some of them walk on their toes, it is in dog fashion, and others are quite plantigrade. The body is generally heavy; tail short; ears short and rounded.

The Indian Badger (*Arctonyx collaris*) is met with in Assam and Arakan. M. Duvancel has described a male and female, in the menagerie of the Governor-General at Barrackpoor, as remarkably shy and wild. The female was, however, less savage than the male, and showed a certain degree of intelligence, giving reason to believe that, if taken young, this animal might be easily domesticated. They passed the greater part of the day buried beneath the straw of their den in deep sleep. All their movements were remarkably slow. Though they did not altogether refuse animal food, yet they exhibited a marked predilection for bread, fruits, and other substances of a vegetable nature. When irritated, they uttered a peculiar kind of grunting noise, and bristled up the hair of their back; if still further tormented, they would raise themselves on their hind legs, like a bear, and appeared, like that animal, to possess a power in their arms and claws not less formidable than their teeth.



THE BADGER (*Meles taxus*).

The Common Badger (*Meles taxus*) is found throughout the British Islands, but is nowhere common. In its natural state it lives chiefly upon roots, fruits, insects, and frogs. Occasionally it attacks the nest of the wild bee, plundering the store of honey without dread of the sting of the bee, which cannot penetrate the thick skin of the badger, even if the long hair of the animal were not sufficient protection.

The badger is about the size of a dog, but its body being broader and flatter, and supported by short legs, it stands much lower than a dog.

The badger prefers a sandy or light gravelly soil in which to make its burrow, which has one external entrance leading into different chambers, and terminating in a circular one at the extremity. This latter is lined comfortably with dry grass and hay, and here it spends the livelong day in repose, moving out only at night in search of food.

The badger leads a most quiet and solitary life, not being found in company even with the females of its own species. Sleeping all day long, rolled up on its bed of warm hay, appears to agree singularly well with it, as it is always fat. Though invariably choosing the most secret recesses of the woods for its abode, where, if anywhere, it could remain in peace, the badger is a scarce animal. The number of its young is usually from three to five annually at one birth. They are suckled for five or six weeks, and then taught to shift for themselves. It is also found in Northern Europe and Asia.

The American Badger (*Taxidea Americana*), according to Sir John Richardson, frequents the sandy plains or prairies which skirt the Rocky Mountains as far north as the banks of the Peace River and the sources of the River of the Mountains, in lat. 58°. It abounds on the plains watered by the Missouri, but its exact northern range has not yet been ascertained. The sandy prairies in the neighbourhood of Carlton House, on the banks of the Saskatchewan, and also on the Red River that flows into Lake Winnipeg, are perforated by innumerable badger-holes, which are a great annoyance to horsemen, particularly when the ground is covered with snow.

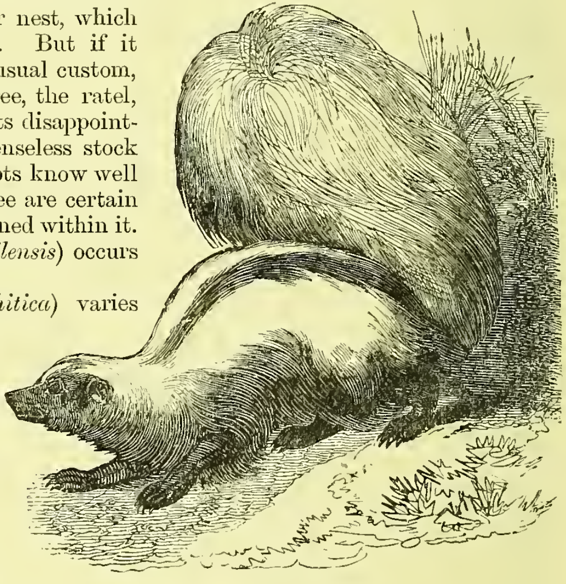
THE RATEL (*Mellivora Capensis*).

These holes are partly dug by the badgers for their habitations, but the greater number of them are merely enlargements of the burrows of the *Arctomys Hoodii* and *Richardsonii*, which the badgers dig up and prey upon. Whilst the ground is covered with snow, the badger rarely or never comes from its hole; and it is supposed that in that climate it passes the winter, from the beginning of November to April, in a torpid state.

The Ratel (*Mellivora Capensis*) is found in Southern and Eastern Africa. The hair all over the body, though tolerably smooth, is remarkably stiff and wiry, and the hide beneath it is excessively tough. It is so loose, that Sparrman says:—"If anybody catches hold of the ratel by the hind part of his neck, he is able to turn round, as it were, in his skin, and bite the arm of the person that seizes him." The claws on the fore feet are extremely long, and though not very strongly curved, of considerable power, being formed especially for digging up the earth, which it is said to perform with great dexterity. Of these claws the middle three are much larger than the lateral, and the internal one is placed far behind the others. On the hind feet the claws, also five in number, are of nearly equal length, but are much shorter, and, proportionably, much less powerful than those of the anterior members. The total length of the animal is about three feet, of which its tail forms little more than a sixth. Its height does not exceed ten or twelve inches, and the length of its fore claws, when not worn down by constant use, is about an inch and a half.

According to Sparrman, the bees furnish the ratel with its principal if not its only means of subsistence. These insects are accustomed to take up their abode in holes in the earth, formed by various burrowing animals, and the ratel is endowed with peculiar sagacity for discovering their nests, which it undermines with its powerful claws, in order to feast on the honey contained in them. Aware that sunset is the period at which the bees return to their homes, it chooses that time for making its observations, which are conducted in a very curious manner. Seated on the ground, with one of its paws raised so as to shade from its eyes the rays of the declining sun, it peers cautiously on either side of this singular kind of parasol, until it perceives a number of bees flying in the same direction. These it carefully marks, and follows in their track till it has safely lodged them in their nest, which it immediately commences pillaging. But if it should happen that, contrary to their usual custom, they have built in the hollow of a tree, the ratel, being unable to climb, and angry at its disappointment, wreaks its vengeance on the senseless stock by biting around it; and the Hottentots know well that such marks on the trunk of a tree are certain indications of a bees' nest being contained within it.

The Chilian Skunk (*Mephitis Chilensis*) occurs all over tropical America.


THE SKUNK (*M. mephitica*).

The Canadian Skunk (*M. mephitica*) varies considerably in marking. Generally it has a white forehead; the eyes are small, and the ears short and round. A narrow white mesial line runs from the tip of the nose to the occiput, where it dilates into a broad white mark. It is again narrowed, and continues so until it passes the shoulders, where it forks, the branches running along the sides, and becoming much broader as they recede from each other. They approach posteriorly, and unite on the rump, becoming at the same time narrower. In some few specimens the white stripes do not unite behind, but disappear on the flanks. The black dorsal line included by the stripes is egg-shaped, the narrow end of which is towards the shoulders. The sides of the head and all the under parts are black. The hair on the body is long. The tail is covered with very long hair, and has generally two broad longitudinal white stripes above on a black ground. Sometimes the colours of the tail are irregularly mixed; its under surface is black.

Sir John Richardson says that the noisome fluid which it discharges is of a deep yellow colour; and that the stench is so durable, that the spot where a skunk has been killed will retain the taint for many days.

The Cape Zorilla (*Ictonyx zorilla*) is met with in tropical Africa and South, as far as the Cape; and the species of Helictis are found in Nepaul, Java, Formosa, and Shanghai.

FAMILY XXXI.—PROCYONIDÆ.

This family contains a small number of bear-like animals, none of them being of large size. They belong to four different genera, elevated to the rank of families by Dr. Gray. They are only met with in America, and some say they represent in the New World the Lemurs of the Old. They climb trees, living partly, and even by preference, on fruits, hunt small birds, and eat eggs with avidity. They form a highly interesting group.

The first genus, Procyon, contains the Raccoon (*P. lotor*), which occurs in North America. It is said to prefer the vicinity of running water, where bushes are thick, or hollow trees, in which it can make its bed. When pursued, it takes at once to the water, swimming with great rapidity and ease. When attacked, it throws itself on its back in an attitude of defence, showing its teeth. There are many varieties. In size, the raccoon is somewhat larger than a badger; its fur is of two kinds: a soft, full under coat, and an upper vest of long and rather coarse hairs. The general colour is dusky grey, the tint arising from each long hair being annulated with white and tipped with black. The face, cheeks, and throat are white, with an oblique black dash across the face, which also spreads round the eyes; the tail has four or five dusky-black rings; the length is about two feet, of which the tail is eight or nine inches. The toes are five on each foot, furnished underneath with thick tubercles; the claws are long, powerful, sharp, and fitted for digging. On the palm, both on the fore and hind feet, there are five distinct elastic pads, or tubercles: one at the base of the little toe, one at the origin of the thumb, one near the second toe, one at the base of the two larger toes, and one towards the wrist and heel.

THE RACCOON (*Procyon lotor*).

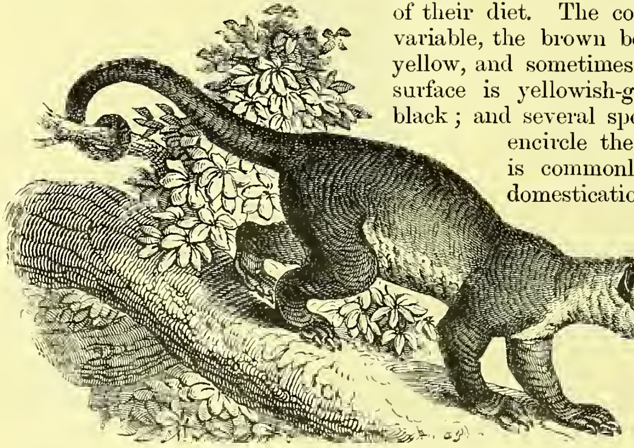
Though incapable of grasping objects with its paws, the raccoon can hold its food between them pressed together—in doing which it usually sits upon its haunches, like a bear, and in this attitude it very often feeds. Left to itself, the raccoon sleeps in its retreat during the day, rolled up in the form of a ball, with the head placed between the thighs. As evening sets in, it begins to prowl for food; roots, succulent vegetables, insects, worms, birds and their eggs, constitute its diet.

The Crab-eating Raccoon (*P. cancrivorous*) is found in South America.

The Coati (*Nasua nasica*) and its allied species may be easily known by the elongated nose, which is not only produced but truncated. The under-side is rounded without any groove. The nostrils are in front, and reach only half-way along its sides. The tail is long, hairy, often obscurely ringed. The coati is to be found in Central and Southern America. In captivity, where they are often seen, these animals sleep much during the day, and are most active as the evening advances; they then traverse their cage, turn their snout from side to side, and pry into every corner. They do not, however, pass the whole of the day in sleep, but are active for hours together, retiring to rest only at intervals. Their temper is capricious; some individuals have been known to be tolerably good-tempered, but most are savage,

THE BROWN COATI (*Nasua nasica*).

and their bite is very severe. In their native climate they tenant the woods, living, for the most part, in small troops among the trees, which they climb with great address, and preying upon birds, which they surprise, rifling also their nests of eggs and unfledged young. Worms, insects, and roots, form also a part of their diet. The colours of these species are very variable, the brown being more or less tinged with yellow, and sometimes shaded with black; the under surface is yellowish-grey; the snout is generally black; and several spots or marks of greyish-yellow encircle the eye. In Paraguay, the coati is commonly kept in a state of semi-domestication, but always tied up or caged, because it cannot otherwise be prevented from climbing about the house, and overturning china, glass, and all light pieces of furniture. In drinking, the coati laps like a dog; but, as its long snout would be in the way of this operation, it turns it up so as to prevent its being submerged. In size, the brown coati is equal to a large cat, its body being twelve or fourteen inches long, and its tail as much.



THE KINKAJOU (*Cercoleptes caudivolvulus*).

All these animals are highly gifted with the sense of smell: they examine everything with their long snout, which is almost in perpetual motion. Their voice, seldom used, is, under ordinary circumstances, a gentle hissing; but when irritated or alarmed, they utter a singularly shrill cry, something like that of a bird.

They defend themselves vigorously when attacked by a dog or any other animal, and inflict dangerous wounds. In climbing they descend head foremost, being, in this respect, unlike the bear, which animal they far surpass in agility.

The Brown Coati (*N. narica*) occurs in Surinam.

The Kinkajou (*Cercoleptes caudivolvulus*) is an arboreal animal, living in Demerara, and having a prehensile tail. It is also found in the great forests of Peru and Brazil. Some years ago, one of these creatures formed part of the collection of the London Zoological Society, where, from its playfulness and good nature, it was regarded as a special favourite. During the day it reposed in a little inner den, but by no means constantly, as—especially in the afternoon—it came out from time to time, and readily engaged in play with those to whom it was accustomed, pretending to bite, and twisting itself into a variety of positions. It was, however, during the dusk of the evening that its energy was fully awakened: then, all play and frolic, it would leap about its cage, climb to the top, and suspend itself with its hind claws and tail to the wires, swinging backwards and forwards in the fullest enjoyment of animal life; then, suddenly bringing its fore paws up, it would traverse the top with its back downwards, displaying no little address and activity. During its gambols, it was constantly protruding its long tongue; and it did so when the food which it wished to obtain was presented at the outside of the cage.

Humboldt says that this organ is made use of to suck the honey from the bees' nests; but it is probably an instrument—as are the long tongues of many other animals—to obtain the insects, eggs, and other food which is found in crevices. It lapped its drink like a dog. It used its fore paws—which were remarkably strong—like a bear, sometimes, but by no means always, to convey the food to its mouth.

Bassaris astuta, called the Cat Squirrel, and often domesticated by the Mexicans, is found in California, Texas, and the highlands of Mexico. Generally classed among the Viverridæ, Mr. Flower shows that it is more nearly related to Procyon. Variabilis has been described by Peters from Guatemala.

FAMILY XXXII.—ÆLURIDÆ.

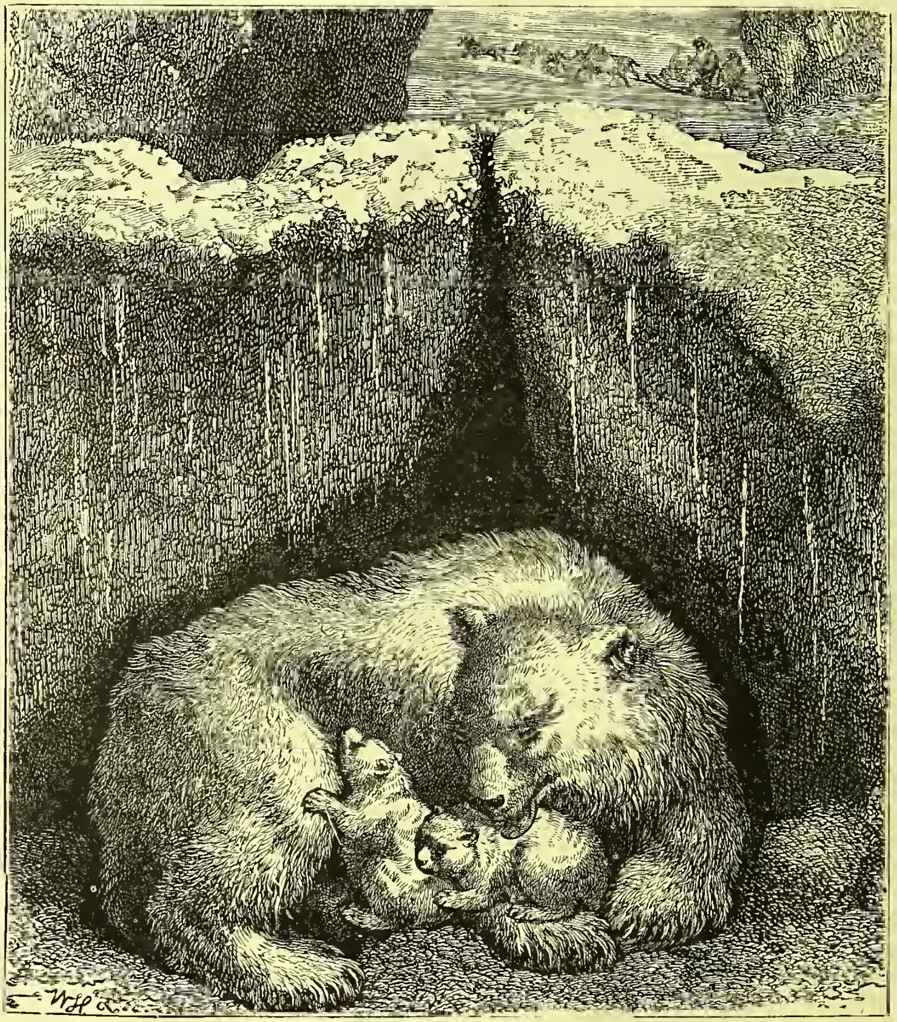
The Panda (*Ælurus fulgens*), of the declivities of the Sub-Himalayas, is a small cat-like bear. It is usually found at an elevation of 7,000 to 9,000, or, according to Dr. Hodgson, as high as 18,000 feet above the sea, and lives chiefly in thick forests. The animal's cry, when angry or attacked, is peculiar. It rises on its hind legs like a bear, and emits a sound which can be very easily imitated by opening the mouth and drawing in the breath through the nose several times in quick succession. Its usual cry is quite different, being very like the chirping of a bird, or a series of short whistles. From Mr. Bartlett's observations on one that lived in the Zoological Gardens, there can be little doubt that it lives on fruits and other vegetable substances. In its movements it strongly resembled the kinkajou. It did not, however, lap, but drank after the manner of a bear. Hodgson says they lap. When given the berries of *Pyrus vestita*, it would grasp the branch in its paw, hold it tightly, and bite off the berries one by one. Although this animal has many affinities to the members of the previous family, we for the moment leave it in a family by itself. *Ailuropoda melanoleucus*, described by A. Milne-Edwards from the East of Thibet, is a bear-like animal coming near to this genus.

THE PANDA (*Ailurus fulgens*).

FAMILY XXXIII.—THE BEARS (*Ursidæ*).

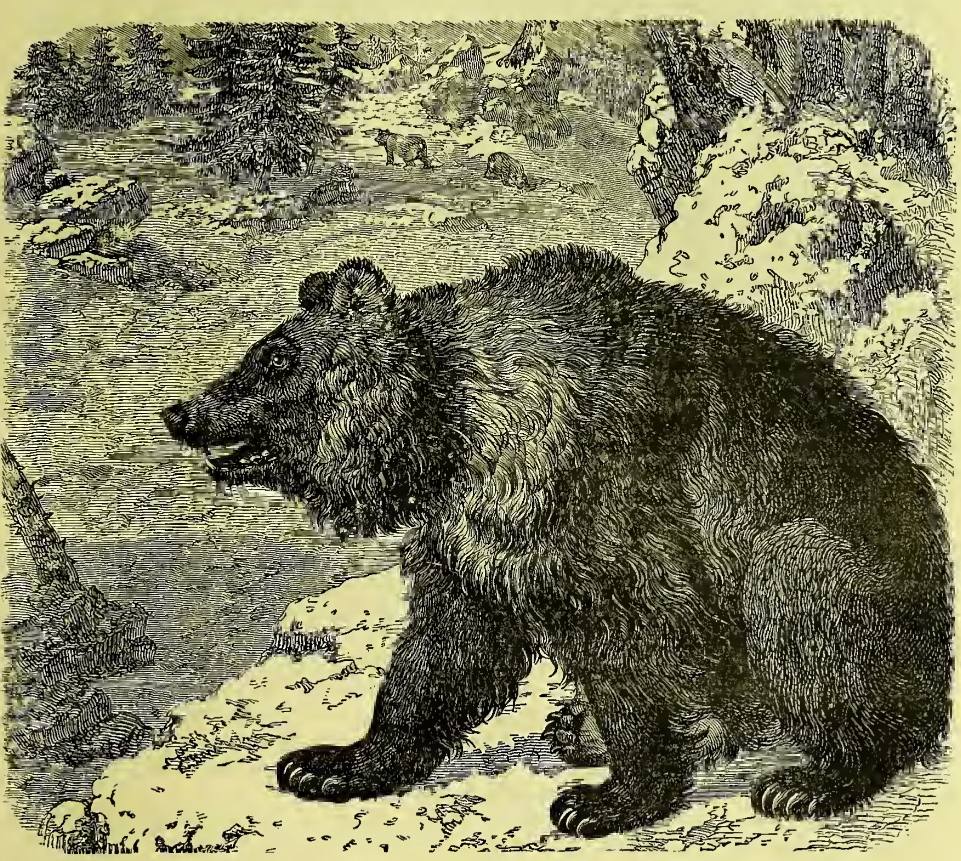
This contains some of the best-known forms of carnivora. They are easily differe tiated from most of the other families, by having their upper grinders, very similar in forn broad and strongly tubercular. They are sometimes called omnivora. The feet are broac and short, generally bald and callous beneath, the toes are straight, the claws exserted, more or less curved, and blunt; the tail is short or none; the body massive, and limbs short. They sometimes climb trees, but generally descend backwards. When in flight, the female bears are said to carry their young ones on their back. The young are born blind and naked, and of a very small size. Their eyes open, and they become covered with a short, thick, black fur, when about five weeks old. Dr. Gray divides the genus into three groups—the Sea, the Land, and the Honey Bears.

The great Polar Bear (*Thalassarctos maritimus*) is the only representative of the first group. It is found along the whole coast of Greenland, from north to south, but not nearly so numerous as in former times or as is popularly supposed. There are more in the northern than in the southern portion of the country; and it is very seldom seen in mid-Greenland, *i.e.*, between about 69° and 66° N. lat. There are yearly killed from thirty to sixty of them. The Company of Royal Merchants in Greenland give the natives about five rigsdaler (11s. 3d.) for the skins. Occasionally there are a number killed near Cape Farewell, which have come round on the annual ice-drift. Here a curious custom prevails, viz., that whoever sights the bear first—man, woman, or child—is entitled to the skin, and the person who has shot it only to the blubber and flesh. It is of light creamy colour, rarely purely white, except when young: hence, the Scotch whalers call it the "Bronnie," or "Brownie," and sometimes the "Farmer," from its very agricultural appearance, as it stalks leisurely over the furrowed fields of ice. Its principal food consists of seals, which it persecutes most indefatigably; but it is somewhat omnivorous in its diet, and will often clear an islet of eider-duck eggs in the course of a few hours. "I have seen it," says Dr. R. Brown, "watch a seal for half a day, the seal continually escaping, just as the bear was about putting its paw on it, at the '*atluk*' (or escape hole) in the ice. Finally, it tried to circumvent its prey in another manner. It swam off to a distance under the ice, with a view to cut off its retreat. It failed, however, and the seal finally escaped. The rage of the animal was boundless; it roared hideously, tossing the snow in the air, and trotted off in a most indignant state of mind. I do not think that the Polar bear is a very fierce animal when not enraged; and I cannot help thinking that a great deal of the impressions which we have imbibed regarding its ferocity are more due to old notions of what it *ought to be* rather than what *it is*, and that the tales related by Barentz, Edward Pelham, and other old navigators, regarding its bloodthirstiness, during the time they wintered in Spitzbergen, were a good deal exaggerated. When enraged, or emboldened by hunger, I can, however, quite well understand that, like all wild, and even domesticated animals, it may be dangerous to man. Though seemingly so unwieldy, the nennok runs with great speed; and being almost marine in its habits, it swims well. I have chased it with a picked crew of eight



THE POLAR BEAR (*Thalassarctos maritimus*).

whalemen, and yet the bear has managed to distance us in the race for the ice-fields. It would every now and again, when its two cubs were getting left in the rear, stop and literally push them up behind; and on reaching the steep edge of the ice-floe, finding that we were fast reaching them, it lifted each of them up on the ice with its teeth, seizing the loose skin at the back of the neck. Once on the ice, they were safe. I do not think that it hybernates during the whole winter, as usually supposed; at all events, they are often seen during the winter, though these are probably old males. It is probable that the females, when not pregnant, roam all winter, like the males. Unlike its congeners, it does not *hug*, but *bites*; and it will not eat its prey until it is dead, playing with it like a cat with a mouse. I have known many men who, while sitting watching or skinning seals, have had its rough hand laid on their shoulder. Their only chance then has been to feign being dead, and manage to shoot it while the bear was sitting at a distance watching its intended victim."



THE BROWN BEAR (*Ursus Arctos*).

The Brown Bear (*Ursus Arctos*) has been extinct in the British Islands for nearly eight centuries, but is still found in most of the high mountain ranges of Europe. Well-marked varieties occur in Siberia, the Caucasus, and the Pyrenees. Another variety, with long shaggy fur of a black-grey colour, is met with in the Amoorland and Japan.

Ray states, on authority, that the brown bear was one of the Welsh beasts of chase; and Pennant adduces the places retaining the name of Pennarth, or the Bear's Head, in proof that it existed in the principality. Nor was it confined to Wales. It is mentioned in the "History of the Gordons," that one of the family, in the year 1057, was directed by the king to carry three bears' heads on his banner, as a reward for his valour in slaying a fierce bear in Scotland.

Sir Thomas Pope entertained Queen Mary and the Princess Elizabeth, at Hatfield, with "a grand exhibition of bear-baiting, with which," adds the historian, "their highnesses were right well content." We cannot be surprised, therefore, that bear-baiting should be described as among "the princely pleasures of Kenilworth Castle." In the Earl of Northumberland's Household Book there is the following:—"Item: My lord usith and accustomyth to gyfe yerly, when his lordship is at home, to his bar (bear) ward, when he comyth to my lorde in Cristmas, with his lordshippe's beests, for makynge of his lordschip pastime, the said xij. days, xxs." In Southwark there was a regular bear-garden, that disputed popularity with the Globe and the Swan Theatres on the same side of the water.

Bear-baiting was, indeed, a favourite amusement of our ancestors. The office of chief master of the bears was held under the Crown, with a salary of sixteen pence a day. Whenever the king chose to entertain himself or his visitors with this sport, it was the duty of the master to provide bears and dogs, and to superintend the baiting. He was invested with unlimited authority to issue commissions, and to send his officers into every county in England, who were empowered to seize and take away any bears, bulls, or dogs that they thought suitable for the royal service. The latest record by which this diversion was publicly authorised is a grant to Sir Saunders Duncombe, dated October 11, 1561, "for the sole practice and profit of the fighting and combating of wild and domestic beasts, within the realm of England, for the space of fourteen years."

The bears of Kamtchatka live chiefly on fish, which they procure themselves from the rivers. A few years ago the fish became very scarce, when, emboldened by hunger, the bears, instead of retiring to their dens, wandered about, and sometimes entered the villages. One day, a bear, finding the outer door of a house open, entered, and the door accidentally closed after him. The woman of the house had just put on the fire a tea-kettle of boiling water; this Bruin smelt. It burnt his nose, when, provoked at the pain, he vented his utmost fury on the tea-kettle. He folded his arms around it, pressed it with his whole strength against his breast to crush it—only, of course, to be more severely burnt. His horrible growling from rage and pain now brought the neighbours to the spot, and a few shots ended his misery. But to this day, when any one injures himself by his own violence, the villagers call him, with great propriety, "the bear and the tea-kettle."

The favourite device in Berne, as all travellers in that part of Switzerland know, is the bear. The prevailing reverence for that animal is shown in the multiplying of its effigy on the coins, sign-posts, fountains, and public buildings, as well as in the armorial bearings of the canton, which is what the French heralds call an *armoirie parlante*—the word "Bern" signifying a bear in old German, or rather in the Swabian dialects.

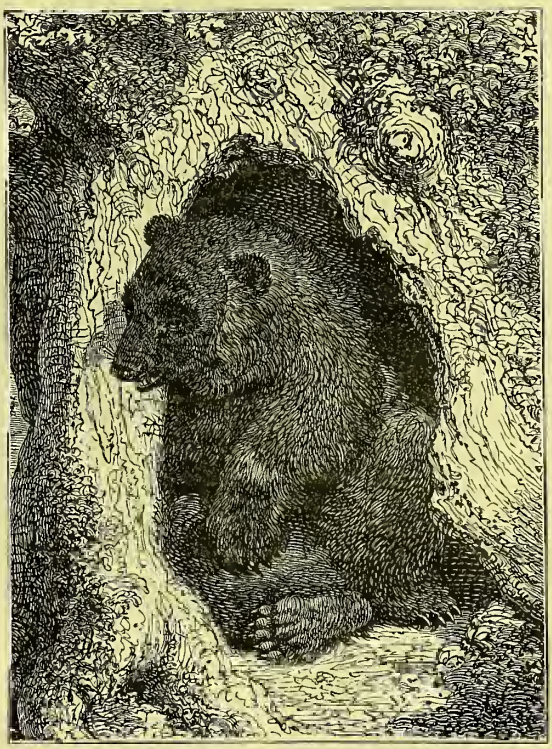
The Syrian Bear (*U. Syriacus*) is found on Mount Lebanon, and elsewhere in Western Asia, and the Himalayan Bear (*U. Thibetianus*) in Assam, and the northern hilly region of Japan and Eastern Siberia. The general colour of the Himalayan Bear is black, but the lower lip is white, and a large Y-shaped mark of the same colour on the breast sends up its branch on each side in front of the shoulder. It is not of large stature. Fruits and other vegetable productions appear to constitute its principal food.

The Black Bear (*Ursus Americanus*) is met with in North America, throughout the United States, and a well-marked variety (*U. cinnamoneus*) is found in the Rocky Mountains and Oregon, and the immense inland forests. In Canada it is still found, and it is tolerably numerous on the western coast, as far as California.

Its favourite food is berries of various kinds, but when these are not to be procured, it preys on roots, insects, fish, eggs, and such birds or quadrupeds as it can surprise. It does not eat animal food from choice; for when it has abundance of its favourite vegetable diet, it will pass the carcase of a deer without touching it. It is rather a timid animal, and will seldom face a man except it is wounded, or has its retreat cut off, or is urged by affection to defend its young. In such instances its strength renders it a dangerous assailant. The female has been known to confront her enemy boldly, until she had seen her cubs attain the highest branches of a tree, when she made off, evidently considering them to be in safety, but leaving them, in fact, an easy prey to the hunter.

This bear, when resident in the fur countries, almost invariably hybernates, and upwards of 10,000 skins are annually procured by the Hudson's Bay Company from black bears destroyed in their winter retreats. It generally selects a spot for its den under a fallen tree, and having scratched away a portion of the soil, retires to it at the commencement of a snow-storm, when the snow soon furnishes it with a close, warm covering. Its breath makes a small opening in the den, and the quantity of hoar frost which occasionally gathers round the aperture serves to betray its retreat to the hunter.

In more southern districts, where the timber is of a larger size, bears often shelter themselves in hollow trees. The Indians remark that a bear never retires to its den for the winter until it has acquired a thick coat of fat, and when it comes abroad is very lean. The period of the retreat of the bears is generally about the time when the snow begins to lie upon the ground, and they do not come abroad again until the greater part of the snow is gone. At both these periods they can obtain many kinds of berries in considerable abundance. In latitude 65° their winter repose lasts from the beginning of October to the first or second week of May, but on the northern shores of Lake Huron the period is from two to three months shorter. The value attached to the skin of the black bear has been for many years greatly diminished. From twenty and even forty guineas it has fallen to from twenty to sixty shillings. In 1783 the importation into England amounted to 10,500 skins; it ascended gradually in 1803 to 25,000, but within the last thirty years there has been a considerable decline.

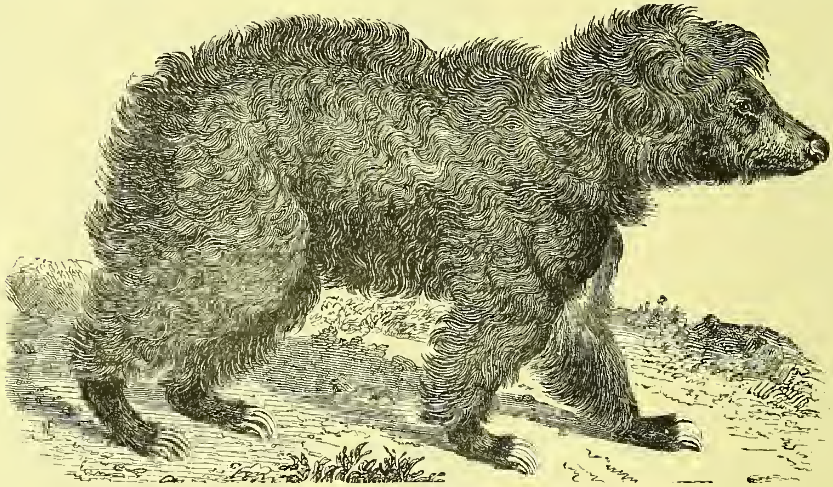

THE BLACK BEAR (*Ursus Americanus*).

The Grizzly Bear (*U. horribilis*) is nearly double the size of the black bear. Lewis and Clarke give the measurement of one as nine feet from the nose to the tail, and state that they have seen one of larger dimensions. It attains the weight of 800 pounds. The length of the fore foot in one of those measured by the travellers just mentioned exceeded nine inches, that of the hind foot was eleven inches and three-quarters, without the talons, and the breadth was seven inches. The claws of the fore feet—which are a good deal longer, and less curved than those of the hind feet—measured in another individual more than six inches. They are well adapted for digging, but not for climbing, and the grizzly bear does not ascend trees. The muzzle is lengthened, narrowed, and flattened, and the canine teeth are highly developed, exhibiting a great increase of size and power. The tail is very small, and so entirely lost in the hair that covers the buttocks, that it is a standing joke among the Indian hunters, when they have killed a grizzly bear, to desire any one unacquainted with that animal to take hold of its tail. The fur, or rather hair, is abundant, long, and varying through most of the intermediate gradations between grey and blackish-brown, which last is prevalent, and more or less grizzled. On the muzzle it is pale and short; on the legs it is darker and coarser. The eyes are small, and rather sunk in the head.

Mr. Drummond, in his excursions over the Rocky Mountains, had frequent opportunities of observing the manner of the grizzly bears, and it often happened that, in turning the point of a rock, or sharp angle of a valley, he came suddenly on one or more of them. On such occasions they reared on their hind legs, and made a loud noise like a person breathing quickly, but much harsher. He kept his ground, without attempting to molest them; and they, on their part, after attentively regarding him for some time, generally wheeled round and galloped off, though, from their known disposition, there is little doubt but he would have been torn in pieces had he lost his presence of mind, and attempted to fly.

When he discovered them from a distance he generally frightened them away by beating on a large tin box, in which he carried his specimens of plants. He never saw more than four together, and two of these he supposes to have been cubs. He more frequently met them singly, or in pairs. He was only once attacked, and then by a female, for the purpose of allowing her cubs to escape. His gun on this occasion missed fire, but he kept her at bay with the stock of it, until some gentlemen of the Hudson's Bay Company, with whom he was travelling at the time, came up and drove her off.

The Malayan Bear (*U. malayanus*) is called Bruang by the Malays. It is a native of Sumatra, Borneo, and Java, and is also found on the Malay peninsula. It is about four feet long from the tip of the nose to the tail, and two feet high on the shoulders. It is remarkable for a peculiar power of protruding the lips. Its tongue is very long, its fur is short and smooth, and its claws are very long. The colour of the upper parts is black, the face and lower parts are buff, and it has a white crescent on its breast. It is fond of sweets, and in its native forest preys upon the hoards of the wild bees, its long, pliable tongue being well adapted in its structure for scooping out the honeycombs from the hollows of the trees. Vegetables form its principal diet, and it is attracted to the neighbourhood of man by its fondness for the young shoots of the cocoa-nut trees, to which it is very destructive.



THE SLOTH BEAR (*Melursus labiatus*).

The Spectacled Bear (*U. ornatus*) occurs in South America and the Andes of Peru. Its fur is smooth, shining, and black, with the following exceptions :—Its short muzzle is of a dirty yellow, or buff colour, and there are two semicircular marks of the same hue, reminding the observer of a pair of spectacles, above the eyes; the under parts of the throat and neck, and the upper part of the breast, are whitish.

The Sloth Bear (*Melursus labiatus*) is found in India, at Nepaul, Benares, and the southern Mahratta country. This animal, on its arrival in Europe, now many years ago, was taken for a sloth. The lips are capable of considerable protrusion, as may be seen if the spectator hold a morsel of fruit or biscuit at a proper distance for exciting the animal to exert this faculty. The muzzle is elongated, and, as well as the ends of the feet, is whitish or yellowish. The forehead rises almost abruptly from the muzzle. Upon the under side of the neck and breast is a white cross-mark. With these exceptions the fur is deep black, with here and there some brown spots, and is rather long, particularly round the breast, in old specimens. In bulk it is about the size of the brown bear. The food of this species in its natural state consists of fruits, honey, and the white ants, which are so numerous and destructive. In captivity it is mild, but melancholy.

SUB-ORDER 2.—PINNIPEDIA.

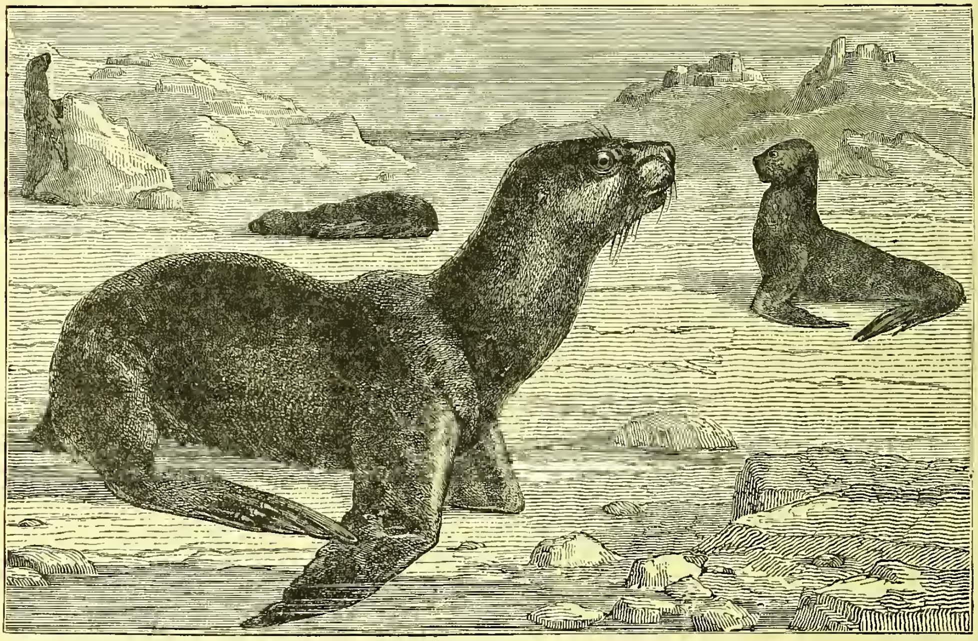
To this section of the order Carnivora belong the Seals and the Walrus. The upper incisor teeth are four or six; the lower four, two, or after a time all deciduous; the molar teeth, with crowns either flat, depressed, or cupsidate, acute; feet short, palmate, pentadactylous: the posterior turned backwards, approximate to each other; toes of the fore feet often decreasing in size from the pollex; the lateral toes of the feet longer than the middle toes; body long, clothed with adpressed hair, smooth and terminated by a very short conical tail. Mr. Flower says there is no question that the cranial characters indicate most strongly the approximation of this sub-order to the section of the Fissipede Carnivora containing the bears. Indeed, their skulls seem to be simply a further modification of this type, showing resemblances to the true bears on the one hand, and the otters on the other. The first family of this sub-order will be

FAMILY XXXIV.—OTARIIDÆ.

This contains the Eared Seals, which are easily distinguished from the true seals by the presence of external ears. The fore limbs are fin-like, situated very far back. The hind limbs are comparatively free, hind feet directed forward when the animal is at rest, and serviceable for terrestrial locomotion. The fingers terminate in long cartilaginous flaps, connected at the base by membranes. In our division we follow Mr. Allen's monograph of this family, who distinguishes between the hair and fur seals, making of these two sub-families. In the first, called Trichophocinæ, or Hair Seals, the under fur is either absent, or present in such small quantity as to render the skins of no value in commerce. This sub-family contains the following species:—The Sea Lion of voyagers in the southern seas (*Otaria jubata*), coasts, and islands of South America, from Chili on the west, and the Rio de la Plata, southwards to the Antarctic Islands, and on the east as far as Peru; the Northern Sea Lion (*Eumetopias stelleri*), coasts and islands of the North Pacific, from California and Southern Kamtchatka northwards; Zalophus gillespii, same distribution as last, but from Southern Japan northwards; Z. lobatus, shores of Australia and New Holland. In the second sub-family, that of the Oulophocinæ, there is a thick under fur (first used as a means of distinction by Professor Peters), and the ears are much longer, while the form is more slender than in those of the former sub-family. We have here Callorhinus ursinus, with a similar geographical distribution to E. stelleri; Arctocephalus falklandicus, with the same habitats as O. jubata; and two species—A. cinereus, from Australia and New Zealand; and A. antarcticus, southern coasts of Africa.

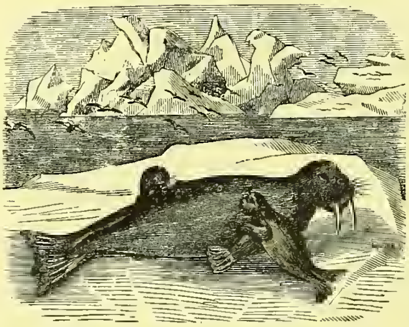
The Northern Sea Lion (*E. stelleri*). "The following careful description of their movements on land has been communicated to me," writes Mr. Allen, "by Mr. Theodore Lyman, who has recently observed the Sea Lions on the 'Seal Rocks' near San Francisco. 'These rocks,' he says, 'are beset with hundreds of these animals—some still, some moving, some on the land, and some in the waters. As they approach to effect a landing, the head only appears decidedly above water. This is their familiar element, and they swim with great speed and ease, quite unmindful of the heavy surf and of the breakers on the ledges. In landing, they are apt to take advantage of a heavy wave, which helps them to get the forward flippers on *terra firma*. As the wave retreats, they begin to struggle up the steep rocks, twisting the body from side to side, with a clumsy worm-like motion, and thus alternately work their flippers into positions where they may force the body a little onward. At such times they have a general appearance of sprawling over the ground. It is quite astonishing to see how they will go up surfaces having even a greater inclination than 45°, and where a man would have to creep with much exertion. When the surface is nearly horizontal, they go faster, and often proceed by gathering their hind-quarters under them, raising themselves on the edges of their fore limbs, and then giving a push, whereby they make a sort of tumble forwards. In their onward path they are accompanied by the loud barking of all the seals they pass; and these cries may be heard a great distance. Having arrived at a good basking-place, they stretch themselves out in various attitudes—often on the side, sometimes nearly on the back, but commonly on the belly, with the flippers somewhat extended. They seem much oppressed with their own weight (which is usually supported by the water), and it seemed an exertion for them even to raise the head, though it is often kept up for a long time. They play among themselves continually by rolling on each other and feigning to bite; often, too, they will amuse themselves by pushing off those that are trying to land. All this is done in a very cumbrous manner, and is accompanied by incessant barking. As they issue from the water, their fur is dark and shining; but, as it dries, it becomes of a yellowish-brown. Then they appear to feel either too dry or too hot, for they move to the nearest point from which they may tumble into the sea. I saw many roll off a ledge at least twenty feet high, and fall, like so many huge brown sacks, into the water, dashing up showers of spray.' " From the accounts given by various observers, the sea lions evidently move with much less facility on land than do the fur seals. Captain Bryant states that the fur seals may be driven at the rate of a mile and a half per hour, while he asserts that the sea lions can be driven with safety only about two miles a day.

The Northern Sea Bear, or the Northern Fur Seal (*C. ursinus*). The following is from the pen of Captain Charles Bryant :—" By the 1st to the middle of April the snow has melted from the shore of St. Paul's Island, near the coast of Alaska, and the drift-ice from the north has all passed. Soon after this period, a few old veteran male seals make their appearance in the water near the island, and, after two or three days' reconnaissance, venture on to the shore, and examine the rookeries, carefully smelling them. If the examination is satisfactory, after a day or two a few climb the slopes, and lay with their heads erect, listening. At this time, if the wind blows from the village towards the rookeries, all fires are extinguished, and all unnecessary noises avoided. These scouts then depart, and in a few days after small numbers of male seals, of all ages, begin to arrive. The old patriarchs soon take their places on the rookeries, and prevent the younger males from landing. They thus compel them to either stay in the water, or go to the upland above. In locating, each old male reserves a little more than a square rod of space to himself. For this proceeding they evidently have two reasons. First, from the constant liability to surprise from their rear, which is their weakest point, they require room enough to make one leap in turning before being able to defend themselves, or to attack their enemies. Their eyes being adapted to seeing in the water, their vision is feeble when they are out of that element. Consequently they have to rely mainly on the senses of hearing and smell for warning of danger; hence, while dozing on the rocks every movement or sound in their



SEA LIONS (*E. stelleri*).

vicinity keeps them constantly turning towards the direction from which it proceeds. A second reason is that each requires that amount of space for the reception of his ten or fifteen wives. Male seals continue to arrive in small numbers daily, a few of which are yearlings; those two, three, four, and five years old arrive in about equal proportions. Those older than this are more numerous than the younger, each one of which fights his way to his old place on the rookery, or, taking a new one, prepares to contend for it in case the owner comes to take it. As they acknowledge no right but that of might, the later comer has to select again. The growling and fighting are constant, so that day and night the aggregated sound is like that of an approaching railway-train. About the 15th of June the males have all assembled, the ground being then fully occupied by them, as they lay waiting for the females to come. These appear in small numbers at first, but increase as the season advances till the middle of July, when the rookeries are all full, the females often overlapping each other. The 'bachelor' seals swim all day along the shore, escorting and driving the females on to the rocks as fast as they arrive. As soon as a female reaches the shore, the nearest male goes down to meet her, making meanwhile a noise like the clucking of a hen to her chickens. He bows to her, and coaxes her until he gets between her and the water, so that she cannot escape him. Then his manner changes, and with a harsh growl he drives her to a place in his harem. This continues until the lower row of harems is nearly full. Then the males higher up select the time when their more fortunate neighbours are off their guard, to steal their wives. This they do by taking them in their mouths, and lifting them over the heads of the other females, and carefully placing them in their own harem, carrying them as cats do their kittens. Those still higher up pursue the same method, until the whole space is occupied. Frequently a struggle ensues between two males for possession of the same female, and both seizing her at once, pull her in two, or terribly lacerate her with their teeth. When the space is all filled, the old male walks around, complacently reviewing his family, scolding those who crowd or disturb the others, and fiercely driving off all intruders. This surveillance always keeps him actively occupied. In two or three days after landing, the females give birth to one pup each, weighing about six pounds. It is entirely black, and remains of this colour the whole season. The young are quite vigorous, even at birth, nursing very soon after they are born. The mother manifests a strong attachment for her own young, and distinguishes its cry among thousands. The voice of the female is like the bleating of a sheep, and the cry of the pup resembles that of a lamb. By the middle of August the young are all born, and the females are again pregnant. The old males, having occupied their stations constantly for four months, without food, now resign their charge to the younger males, and go to some distance from shore to feed. The fact of their remaining without food seems so contrary to nature, that it seems to me proper to state some of the evidences of it. Having been assured by the natives that such was the fact, I deemed it of sufficient importance to test it by all the means available. Accordingly I took special pains to examine daily a large extent of the rookery, and note carefully the results of my observations. The rocks on the rookery are worn smooth and washed clean by the spring tides, and any discharge of excrement could not fail to be detected. I found, in a few instances, where newly-arrived seals had made a simple discharge of red-coloured excrement, but nothing was seen afterwards to show that such discharges were continued, or any evidence that the animals had partaken of food. They never left the rocks, except when compelled by the heat of the sun to seek the water to cool themselves. They are then absent from the land for but a short time. I also examined the stomachs of several hundred young ones, killed by the natives for eating, and always without finding any traces of food in them. The same was true of the few nursery females killed for dissection. On their arrival in the spring they are very fat and unwieldy, but when they leave, after their four months' fast, they are very thin, being reduced to one-half their former weight. The female has four teats, two on each side, equidistant, and in line between the fore and hind flippers. Their milk is of a yellowish colour, composed of water and caseine, very insipid, and containing no sugar. The pups nurse but seldom, and when separated from the mother for thirty-six hours and returned to her again, they seem in no haste to do so, and in some cases did not for several hours afterwards. About the 20th of July the great body of the previous year's pups arrive, and occupy the slopes with the youngest class of males, and they continue to be mixed together during the remainder of the season. The two-year-old females, which pair with the young males in the water near the island, also now associate with the other females. The pups are five weeks old when the old females go off to feed; they go with the mothers to the upland, but keep by themselves. The pups born on the lower edge of the rookery, where the surf breaks over them occasionally, learn to swim early, but the larger portion of them do not take to the water until later, and many have to be forced in by the parent. Once in, however, they soon love to sport in it. The young are taught to swim by the old males on their return from feeding. By the last of October the seals begin to leave the islands in small companies. The males going last and by themselves. About November the seals stop a few days to rest on the Aleutian Islands."



THE WALRUS AND YOUNG.

FAMILY XXXV.—THE WALRUSES (*Trichechidæ*).

The Walrus (*Trichechus rosmarus*) is the only species belonging to this family. It is to be met with in the North Polar regions, coming a little south of the Arctic Circle on both the east and west coasts of America. It is very abundant at Spitzbergen. In early times the Walrus was called a Horse-whale, and seems to have been known in England as early as the year 890, during the reign of King Alfred; for Hakluyt states, that during that year a voyage was made beyond the North Cape by Octher, the Norwegian, "for the mere commoditie of fishing of horse-whales, which have in their teeth bones of great price and excellence! whereof he brought some on his returne to that king." The same writer says that the skins of horse-whales and seals were converted into cables of sixty ells in length by the natives of northern Europe.

The walrus is an obstinate animal, and does not fly on the approach of man; on the contrary, forming themselves into a body, they resist any attempt on his part to proceed.

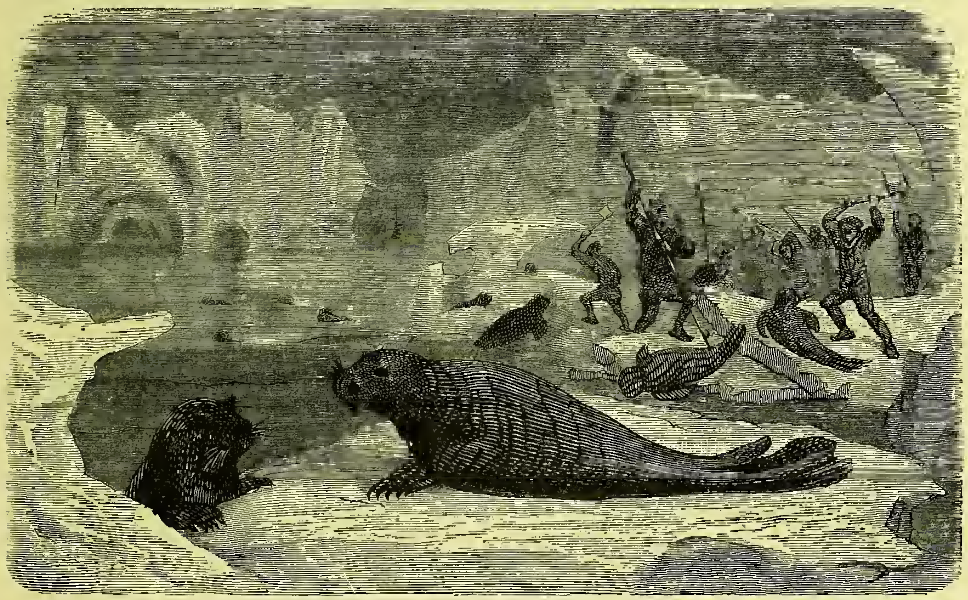
Captain Cook describes his meeting with a herd of walruses off the north coast of America. "They lie," he says, "in herds of many hundreds upon the ice, huddling over one another like swine; and roar or bray so very loud, that in the night, or in foggy weather, they gave us notice of the vicinity of the ice before we could see it. We never found the whole herd asleep, some being always upon the watch. These, on the approach of the boat, would awake those next to them; and the alarm being thus gradually communicated, the whole herd would be awake presently. But they were seldom in a hurry to get away, till after they had been once fired at. They then would tumble over one another into the sea, in the utmost confusion; and if we did not, at the first discharge, kill those we fired at, we generally lost them, though mortally wounded. They did not appear to us to be that dangerous animal which some authors have described, not even when attacked. They are more so in appearance than reality. Vast numbers of them would follow, and come close up to the boats; but the flash of the musket in the pan, or even the bare pointing of one at them, would send them down in an instant. The female will defend her young to the very last, and at the expense of her own life, whether in the water or upon the ice. Nor will the young one quit the dam, though she be dead; so that, if one is killed, the other is certain prey. The dam, when in the water, holds the young one between her fore arms."

THE COMMON SEAL (*Callocephalus vitulinus*).

FAMILY XXXVI.—THE TRUE SEALS (*Phocidæ*).

The True Seals are met with in both hemispheres, being generally found in the temperate and cold regions. They live in the sea, though sometimes in brackish water at the mouth of rivers. The structure of their body is adapted exclusively for rapid and sustained swimming. When on shore, they have to creep along, curving their spines up and down like a gigantic caterpillar. They like to sun themselves. They live principally on fish, but not molluscs or crustacea. Their note is a dog-like bark to be heard on crags, and, it is said, on the approach of rain. Their body is covered with a harsh fur, lying close to the skin; they have long whiskers attached to their upper lip. Dr. Gray distributes the eighteen species in thirteen genera. We can only allude to a few of these.

The Common Seal (*Callocephalus vitulinus*), often seen on the rocky coasts of Scotland and Ireland, is abundant along the northern shores of Europe and America, and is found in the Caspian Sea and the fresh-water lakes of Russia and Siberia. Its average length is about five feet; its colour is yellowish-grey, clouded or dappled with brown or yellow; the lips are furnished with long, stiff whiskers; there are no external ears.



And yet, so fine is the sense of hearing, that the seal is attracted by musical sounds. Sir Walter Scott says :—

> "Rude Heiskar's seals, through surges dark,
> Will long pursue the minstrel's bark."

Nor is this assertion merely poetic. Laing, in his "Voyage to Spitzbergen," states that, when a violin was played on board the vessel, it would generally draw around it a numerous audience of seals, which would even follow it for miles.

Gregarious in its habits, the seal frequents the deep recesses and caverns of our northern shores, to which it resorts for a breeding-place. Here, during winter, the female produces her young, generally two at a birth, suckling them for a few weeks on the spot, till they are strong enough to be conveyed by their parent to the water. She displays great solicitude for their safety, teaches them to swim and pursue their finny prey, and carries them, when fatigued, on her back.

This seal, in common with others, is hunted for the sake of its skin and blubber. In Finland, seal-hunting is a favourite and profitable pursuit. When the ice begins to break up, a few men go to sea in a boat, notwithstanding all the horrors of floating amidst broken fields of ice, which every instant threatens the annihilation of their slender bark. In such situations seals frequently repose on the shoals; here, therefore, some of the party land, and, creeping on their hands and feet, cautiously steal on the animals and kill them during their sleep.

According to Crantz, the flesh supplies the natives with their most palatable and substantial food. Their fat furnishes them with oil for lamp-light, chamber, and kitchen fire; and, whoever sees their habitations, presently finds that if they even had a superfluity of wood it would be of no use: they can use nothing but train-oil in them. They also mollify their dry food, mostly fish, in the oil; and, finally, they barter it for all kinds of necessaries with the factor. They can sew better with the fibres of the seal's sinews than with thread or silk. Of the skins of the entrails they make their windows, curtains for their tents, and shirts; part of the bladders they use for their harpoons; and they make train-bottles of the stomach. Neither is the blood wasted, but boiled, with other ingredients, and eaten as soup. Of the skin of the seal they stand in the greatest need, because they must cover over with seal-skin both their large and small boats, in which they travel and seek their provision. "They must also," Crantz adds, "cut their thongs or straps out of them, and cover their tents with them, without which they could not subsist in summer. Therefore, no man can pass for a right Greenlander who cannot catch seals. This is the ultimate end they aspire to in all their device and labour, from their childhood up."

This is also, probably, the same species as is found in that most remarkable lake, Baikal, in Siberia. It is understood that large seals having a coarse grey fur are common in this immense lake, the waters of which are fresh, and the level of which is 1,800 feet above that of the sea. A large number of specimens have been lately captured by Dr. Dybowski, from whom we may shortly expect a monograph on the subject. Another variety, by some elevated to the rank of species, is found in the Caspian Sea, another inland lake, the waters of which are salt, and lie at a level of eighty-four feet below the sea-level.

The Ringed Seal (*Pagomys fœtidus*) is also met with in the North Sea, on the coasts of England and Lake Baikal. It is the smallest of the Greenland seals, but its skin forms the chief material for clothing for the natives.

The Harp Seal (*Pagophilus grœnlandicus*) is said not to be very rare in the Shetlands, coming into the deep sheltered coves at Balta Sound in very bad weather. It is well known off the coast of Newfoundland, where the males have on their backs the harp-shaped band, and are called saddle-backs. It is also common in the North Atlantic and Pacific. The females are smaller than the males, and differently marked. It is looked upon by the Greenlanders as rather a careless, stupid seal, easily caught, and it feeds on small fish, crustacea, and even mollusca. It is, however, of vast importance to him for its oil, flesh, and hide. Dr. R. Brown tells us that a full-grown animal, weighing on an average 230 lbs., will yield in skin and blubber about 100 lbs., and in meat about 90 lbs. Rinke says that the yearly take on the Danish settlements is about 36,000.

Phoca barbata. This is the largest seal found in the Northern Sea, and has often been confounded with the next species.

The Grey Seal (*Halichoerus grypus*) is met with around the north and west coasts of Scotland and Ireland. Dr. R. Ball thought that the Irish species might prove distinct. A specimen in the Dublin museum obtained by Mr. A. G. More is fully eight feet in length. The Monk Seal (*Monachus albiventer*) inhabits both sides of the Mediterranean, coming out into the North Atlantic, and extending southwards to Madeira and the Canaries.

The Sea Leopard (*Stenorhynchus leptonyx*) is met with in the Antarctic seas, and wanders to the coast of New Zealand. This is also the haunt of Ommatophoca rossii, and of the Crab-eating Seal (*Labodon carcinophaga*).

The Sea Elephant (*Morunga elephantina*) is known to all readers of the "Early Voyages Round the World." It was figured by Anson in 1786. It is the largest of the seals, the adult males reaching the enormous length of twenty-five and thirty feet, and a circumference of from fifteen to eighteen. The nose of the males is most singularly prolonged into a short proboscis, which is said to lie flaccid over the upper lip when the animal is in a state of repose, but when he arouses himself, or respires violently, the proboscis becomes elongated to about a foot in length, quite changing the aspect of the animal. The female is smaller, and wants the proboscis. Found only in the southern hemisphere, this seal seems to frequent the most desert islands. Herds of it are found in Kerguelen's Land, and other islands in the Antarctic seas. They seem to be of an extremely mild and docile disposition. Their skin, from its great thickness, is not considered valuable, but they yield a prodigious quantity of oil, and the numbers slain each year must be immense.

The Bladder-nose Hooded Seal (*Cystophora cristata*) is the last of the true seals that we have space to refer to. It inhabits the North Atlantic, is found all over the Greenland seas, and rare stragglers every now and then land on the shores of Great Britain. In its adult state this seal is easily distinguished by the curious bladder-like appendage to its forehead, which is connected with the nostrils, and can be inflated at will. It is said to be the fiercest, as it is mostly the largest, of the Greenland seals.

The following notes of the commercial importance of the Northern Seal fisheries is from Dr. Brown's paper, already so often alluded to :—

"The Greenland (*i.e.*, Spitzbergen) sealing fleet from the British ports meet about the end of February in Bressa Sound, off Lerwick, in Zetland. It leaves for the north about the first week in March, and generally arrives at the ice in the early part of that month. The vessels then begin to make observations for the purpose of finding the *locus* of the seals; and this they do by crawling along the edge of the ice, and occasionally penetrating as far as possible between 71° and 73° N. lat., then continue sailing about until they find them, which they generally do about the first week of April. If they do not get access to them, they remain until early in May, when, if they intend to pursue the whaling in the Spitzbergen sea that summer, they go north to about 74° N. lat., to the "old sealing," or, further still (even to 81° N. lat.), to the whaling. Most of them, however, if not successful by the middle of April, leave for home, to complete their supplies in order to be off by the 1st of May to the Davis's Straits whale fishery. The number of seals taken yearly by the British and Continental ships in the Greenland sea, when they get among them, will average upwards of 200,000, the great bulk of which are young 'saddlebacks,' or in the language of the sealer, 'whitecoats.' The general average is about 100 seals to the tun. In 1859 good oil sold for about £33 per tun; add to this the value of 100 skins at 5s. each, and the whole will amount to £58 sterling. From this simple calculation a very good estimate may be formed of the annual commercial value of the Greenland 'Seal Fishery;' for, supposing 2,000 tuns of oil be about the annual produce, and assuming £58 as the value per tun, inclusive of the skins, the whole produce of the fishery will amount to the yearly value of £116,000 sterling (Wallace). This, of course, does not take into calculation the produce the Danish Government derives from their colonies on the west coast of Greenland (which I notice under the head of each seal), nor what the Russians derive from the coast of Spitzbergen, and from the White Sea. The 'fishery,' however, is very precarious. Some years little or nothing is got, the ice being too thick for the ships to 'get into them.' There seems little doubt that the fishery must fail in course of time, as have the seal and whale-fisheries in some other parts of the world; and if seal-hunting is pursued with the energy it is at present, that day cannot be far distant. Some of the sealers laugh at this idea; but where is the enormous produce the South Seas used to yield, superior to anything ever heard of in the north? No doubt the South Sea hunters said the same thing; and doubtless when the inhabitants of Smeerenberg, that strangest of all strange villages, saw the whales sporting in thousands in their bays, and the oil-boilers steaming above the peaks of Spitzbergen, they laughed at the idea of their ever becoming scarce! Yet how false that idea has proved! for in our day the waters of those high northern seas are rarely troubled, even by a wandering Mysticete that, perchance, may have missed its way in making a passage from one secure retreat to another. So will it ultimately be with the seals. Indeed, some are even now of the opinion that they are diminishing in numbers; at least, they have evidently reached their zenith, as shown by statistics; and taking into consideration the appearance the young seals presented on the ice in 1861, they did not approach the numbers reported to have been seen by sealers in many previous years. The South Sea 'fisheries' became extinct in fifteen years, and making all allowance for the protection afforded to the Greenland seals by the ice, and supposing the sealing prosecuted with the same vigour as at present, I have little hesitation in stating my opinion that, before thirty years shall have passed away, the 'seal-fishery,' as a source of commercial revenue, will have come to a close, and the progeny of the immense number of seals now swimming about in the Greenland waters will number but comparatively few. This event will then form another era in the northern fisheries."

ORDER V.—THE WHALES (*Cetacea*).

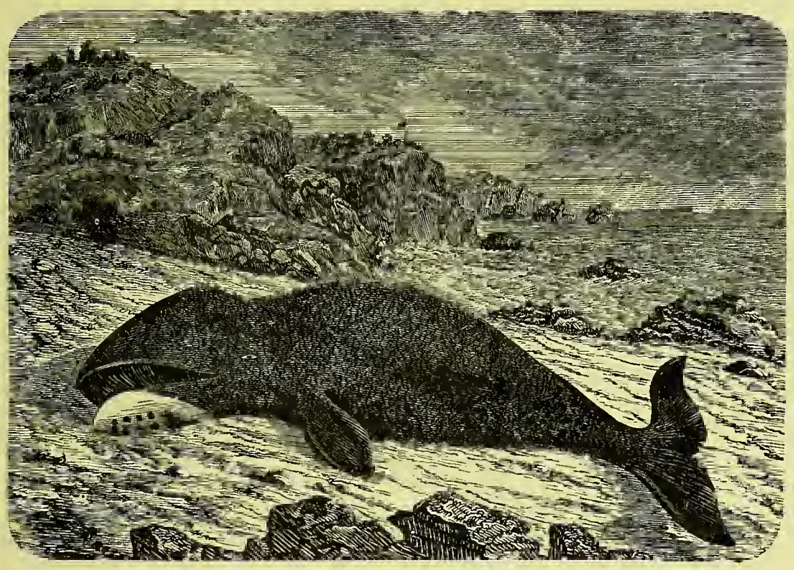
The species of this order, which contains the Whales and Dolphins, live almost exclusively in the sea. Among them are to be found the largest living mammals; indeed, the largest living animal. A thick layer of fat (blubber) under the cuticle protects these animals from the cold of the regions in which some of them live, and diminishes their specific gravity. The skin is without hair, though a few bristles are sometimes to be met with. They are all carnivorous. There are six families of the order, arranged in two sub-orders—one without, the other with teeth.

SUB-ORDER 1.—MYSTACOCETI.

FAMILY XXXVII.—THE RIGHT WHALES (*Balænidæ*).

This contains the Right or Whalebone Whales. They are to be met with in the temperate and cold seas of both hemispheres. They have transverse horny laminæ adhering to the upper jaw in place of teeth, which are only present in the early embryo condition. They wander in the northern hemisphere as far south as the coast of Spain, and have entered the Mediterranean; and from the southern hemisphere they have come as far north as the Cape of Good Hope. They have no back or dorsal fin.

The best known species is the Greenland Whale (*Balæna mysticetus*). It attains a length of upwards of sixty feet, has the longest baleen or whalebone, some 300 pieces on each side. Its food consists of medusæ and minute oceanic mollusca (*Pteropods*). The Greenland whale is a gregarious animal, being generally found in small "schools" of three and four; but when travelling from one part of the ocean to another, they will sometimes collect in large parties. "I am told by my friend Dr. James M'Bain, R.N.," writes Dr. R. Brown, that about thirty years ago he witnessed an extraordinary migration of this nature a little to the south of Pond's Bay. The whales, to the number of several hundreds, passed north in a continuous flock, and a few days afterwards were succeeded by an even still more numerous herd of walruses. The numbers of the latter were beyond all computation: hour after hour did they travel to the northward, never pausing to feed, but all seemingly intent on reaching the opening of Lancaster Sound. A few days subsequently not one was to be seen, as previously there had been no signs of their presence. The rate at which a whale travels from place to place whilst feeding, or under other ordinary circumstances, may be stated as being about four miles per hour. Like most of the Cetacea, it generally travels in a course contrary to that of the wind. Its food consists, for the most part, of Entomostraca and Pteropoda, but chiefly of the former, and especially of Cetochilus arcticus (Baird), and Cetochilus septrionalis (H. Goodsir), Arpacticus kronii (Kroy), &c., which are chiefly found in those portions of the sea of the olive-green colour described by Scoresby. This appearance has been shown to be produced by vast quantities of Diatomaceæ, chiefly Melosira arctica, on which the 'whale's food' subsists. It is not, I am of opinion, compatible with facts to suppose that this whale's food is composed in any part of fishes proper, except, perhaps, a minute individual which may now and then accidentally find its way into its stomach with the mass of maidre (as the whale's food is called). Many of the old whalers contend otherwise, and will adduce measurements of the diameter of the gullet in proof that much larger animals than Acalephæ, Pteropoda, or Entomostraca, could be received in the stomach. I have never measured the orifice of any œsophagus which exceeded two inches and a half in diameter, though, as these observations were generally made on young whales, it is not improbable that this size may be exceeded in some individuals. The 'blowing,' so familiar a feature of the Cetacea, but especially of the Mysticete, is quite analogous to the breathing of the higher mammals, and the 'blow-holes' are the perfect homologues of the nostrils. It is most erroneously stated that the whale ejects water from the 'blow-holes.' I have been many times only a few feet from the whale when 'blowing,' and though purposely observing it, could never see that it ejected from its nostrils anything but the ordinary breath, a fact which might almost have been deduced from analogy. In the cold Arctic air this breath is generally condensed, and falls upon those close at hand in the form of a dense spray, which may have led seamen to suppose that this vapour was originally ejected in the form of water. When the whale is wounded in the lungs, or in any of the blood-vessels immediately supplying them, blood, as might be expected, is ejected in the death-throes along with the breath. When the whale-man sees his prey 'spouting red,' he concludes that its end is not far distant; it is then mortally wounded. Their love of their offspring is so strong, that though the cubs are of very little value, yet the whalers often make a point of killing them, in order to render the mother more accessible. The *sight*, *hearing*, and *smell* of the whale are all very acute in the water, but are very dull out of it. The power of the Cetacea for remaining beneath the surface of the sea seems to bear a direct ratio to their size. Under ordinary circumstances, the Greenland whale will generally remain no longer than half an hour without rising again to breathe; the cubs are, however, more stubborn, and will often remain more than three-quarters of an hour. All species of the Cetacea seem to pass a considerable portion of their time asleep on the surface of the water. and in this position they are often struck. The Greenland whale always keeps near the land-floes of ice; and its migrations north and west seem to be due to this habit. After man, the chief enemy of the whale is Orca gladiator, the most savage of all the Cetacea, and the only one which feeds upon other animals belonging to the order. The Thresher Shark (*Carcharius vulpes*), the very existence of which Scoresby seemed to doubt, but which is now so comparatively well known to naturalists and seamen, is also an enemy of the whale. It is doubtful, however, whether it attacks it in life, or only preys upon it after death. The *Advice* (Captain A. Deuchars) once took a dead whale alongside which this shark was attacking in dozens, the belly being perfectly riddled by them. The Greenland Shark (*Scymnus borealis*, Flem.), though it gorges itself with the dead whale, does not appear to trouble it during life. Marten's most circumstantial account of the fight between the whale and swordfish seems to have originated in a misconception, this name being applied by seamen not only to the Scombroid fish (*Xiphias*), but also to the Orca, which, it is well known, fights furiously with the Greenland whale. This whale must attain a great age, nor does it seem to be troubled with many diseases. Where the whale goes to in the winter is still unknown. It is said that it leaves Davis Strait about the month of November, and produces young in the St. Lawrence River, between Quebec and Camaroa, returning again in the spring to Davis Strait."



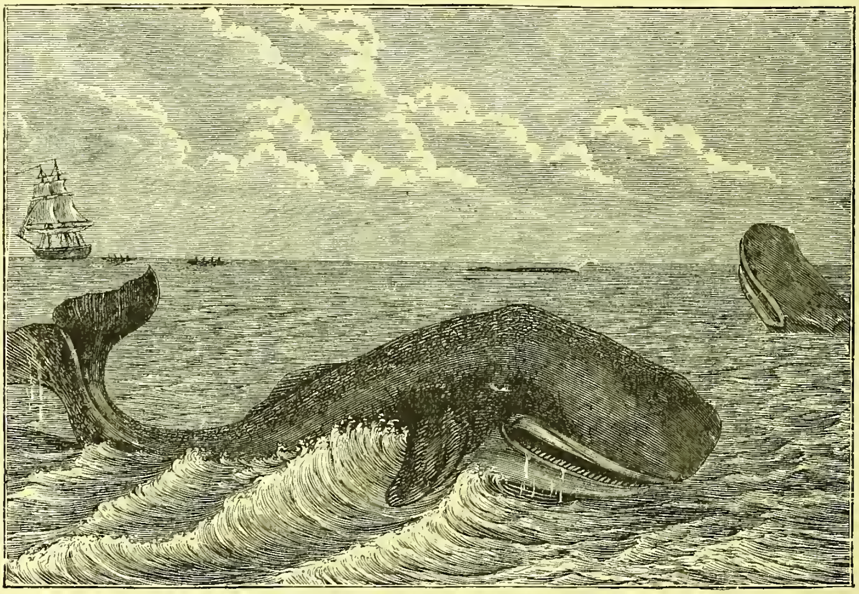
THE GREENLAND WHALE (*Balæna mysticetus*).

The Southern Right Whale (*Eubalæna australis*) seems to take in the southern seas the place that the last-mentioned species does in the northern oceans.

FAMILY XXXVIII.—THE RAZOR-BACKS (*Balænopterida*).

We have here the Rorquals, or Fin-fishes. These have an adipose or fatty fin on their back, and are the Razor-backs of our English whalers. Their whalebone, although present, is little developed, and worthless, and they afford less blubber. They are more numerous in the northern than in the southern hemisphere, and occasionally enter tropical seas. They prey on cod and other fish, which they devour in immense quantities.

The Common Fin Whale (*Physalus antiquorum*) is to be met with off the coasts of South Greenland. They often wander into the European seas toward Rockall, in pursuit of cod; and Dr. R. Brown cites an instance of where 800 were found in the stomach of one whale. This species grows to an immense size. Dr. Schlegel refers to specimens stranded on the coasts of the North Sea of more than eighty feet in length. It is accounted almost worthless by the whalers; and on account of the small quantity of oil which it yields, and the difficulty of capture, it is never attacked by them, unless by mistake or through ignorance. The blubber is hard and cartilaginous, not unlike soft glue. Its blowing can be distinguished at some distance, by being whiter and lower than that of Balæna mysticetus.



THE SPERM WHALE (*Physeter macrocephalus*).

The Lesser Fin Whale (*Balœnoptera rostrata*). This whale, according to Dr. R. Brown, comes only in the summer months to Davis Straits and Baffin's Bay. It is never killed by the natives.

The Humpback Whale (*Megaptera longimana*) is found in the North Sea. It frequents the coast of Greenland only during the summer. Its blubber yields but little oil: the whalebone is short, and not of much value; and so, though one of the most common whales on the Greenland coast, it is very rarely killed.

SUB-ORDER 2.—ODONTOCETI.

FAMILY XXXIX.—SPERM WHALES (*Physeteridæ*).

With the species of this family we enter upon the consideration of a section of the Cetacea which contains whales having teeth in their lower jaw, and no whalebone. These teeth are large, conical, often occurring in rows; they have an internal cavity. In a few instances teeth are found in the upper jaw, concealed under the gums. The costal cartilages are not ossified. The greater number of the cervical vertebræ are anchylosed together. A dorsal fin is usually present. Mr. Flower divides the family into the Physeterinæ, where the lower jaw has numerous teeth, and Ziphiinæ, where the lower jaw has only one or two pairs of teeth (besides the rudimentary concealed teeth). The first sub-family contains the Sperm Whale (*Physeter macrocephalus*). Mr. Flower says that there is but one species of this genus. The Cachalot, or Sperm Whale, which is an inhabitant of the tropical and warmer parts of the temperate seas, passes freely from one temperature into another: they are known to round Cape Horn, they abound in the Indian Ocean off the Seychelles, and it must be regarded as a very accidental straggler in the Arctic or European seas. In length it seldom exceeds sixty feet.

In the second sub-family we have Hyperodon Butzkopf, which is occasionally cast ashore on the coasts of Great Britain. It seems to be rare off the Greenland coast. It chiefly feeds on Cephalopods, and will yield as much oil as a narwhal.

Berardius arnouxii is found in New Zealand, and its skeleton has been fully described by Mr. Flower.

Mesoplodon sowerbiensis has been found stranded at Ostend, Havre, and on two occasions in Brandon Bay, on the west of Ireland.

Ziphius cavirostris has occurred on the coast of Corsica, at Villa Franca, and on the Atlantic coast of France.

FAMILY XL.—THE LONG-NOSED DOLPHINS (*Platanistidæ*).

In this family we have the Long-snouted Dolphins, found inhabiting the large fresh-water rivers of the Atlantic coast of South America and of Asia. Like the species in the last family, the costal cartilages are not ossified, but the neck vertebræ are all free. The jaws are very long and narrow, both having numerous teeth with compressed fangs. The dorsal fin is rudimentary. But four species are at present known. Platanista gangeticus lives in the mouths of the Ganges, and attains a length of seven feet, and is remarkable for its long sword-shaped snout, laterally compressed, and by its eyes being so small that it might be supposed to be quite blind. The blow-hole is a longitudinal fissure. Mr. Blyth describes a second species from the river Indus.

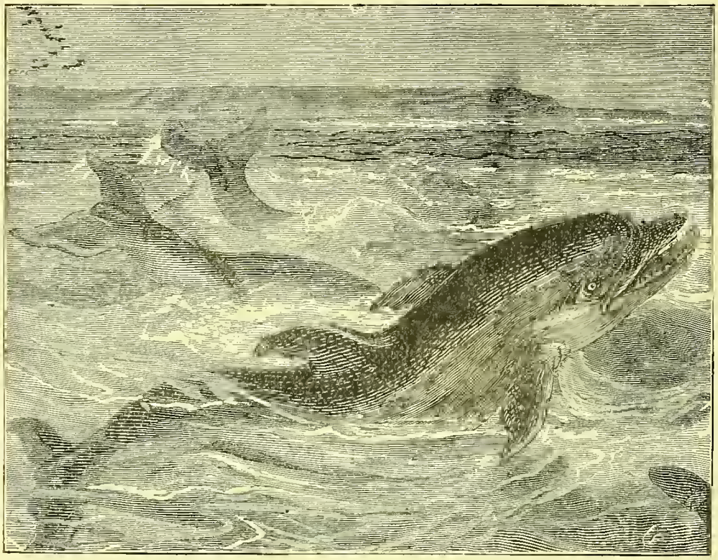
Inia geoffrensis is another somewhat similar form, inhabiting the upper waters of the Amazon and its great tributary streams. It is known to one of the Indian tribes of Bolivia as the Inia, and has a long, narrow, almost cylindrical, beak, furnished with a few stout, crisp hairs. Its pectoral fins are broad, long, and obtuse. Its dorsal fin is a mere ridge, and they have a remarkable development of a large lobe on the inner side of all the posterior teeth.

Pontoporia Blainvillii is apparently a long-nosed fluviatile dolphin, belonging to this family. The only specimens known were taken at the mouth of the Rio de la Plata. The skull of this species has been fully described by Mr. Flower.

FAMILY XLI.—THE DOLPHINS (*Delphinidæ*).

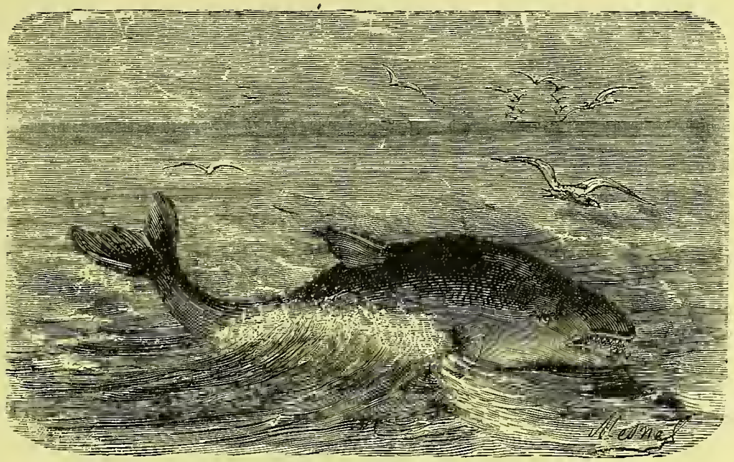
This is the last family of teeth-bearing whales. Here the costal cartilages are firmly ossified, and the anterior cervical vertebræ (2—6) are in most anchylosed together. Except in one genus (*Monodon*) there are numerous teeth in both jaws. The snout is short. Mr. Flower divides the Dolphins into two sub-families. The first is that of the Beluginæ. We have here two genera containing some well-known forms.

The White Whale (*Beluga catodon*) is beyond all question, writes Dr. R. Brown, so far as its importance to the Greenlanders and Eskimo is concerned, *the* whale of Greenland. Like the narwhal, it is indigenous, but is only seen on the coast of Danish Greenland during the winter months, leaving the coast south of 72° N. lat. in June, and roaming about at the head of Baffin's Bay and the western shores of Davis Strait during the summer. In October it is seen to go west, not south, but in winter can be seen, in company with the narwhal, at the broken places in the ice. Its range may be said to be the same as the narwhal's, and during the summer months corresponds with that of the right whale, of which it is looked upon as the precursor. It, however, wanders farther south than the narwhal, being found as a regular denizen as far south as 63° N. lat., though on the opposite coast it reaches much farther south, being quite common in the St. Lawrence river. The Greenlanders during the summer kill great numbers of them, and preserve their oil and dry their flesh for winter use. Of this animal, and the narwhal, about 500 are yearly caught; but the majority of this number consists of the white whale. It feeds on Crustacea, fish, and Cephalopoda; but in the stomach is generally found some sand. The Greenlanders often jocularly remark, in reference to this, that the Kelelluak takes in ballast. Great numbers are caught by means of nets at the entrance of fjords and inlets, or in the sounds between islands. The young are darker coloured than the adult, and can at once be distinguished among the herds of the ordinary waxy white colour. It is said to be rarely seen far from land. The males and females are together in the drove, and not separate, as has been stated. Their blast is not unmusical; and when under the water, they emit a peculiar whistling sound, which might be mistaken for the whistle of a bird, and on this account the seamen often call them sea-canaries. It is rarely that the whalers kill a white whale, their swiftness and activity giving them more trouble than the oil is worth. They are sometimes also called "sea-pigs," from their resemblance to that animal when tumbling about in the water.



THE DOLPHIN (*Delphinus delphis*).

The Narwhal (*Monodon monoceros*) is gregarious, generally travelling in great herds. "I have seen," says Dr. Brown, "a herd of many thousands travelling north on their summer migrations, tusk to tusk and tail to tail, like a regiment of cavalry, so regularly did they seem to rise and sink into the water in their movements in swimming. It is very active, and will often dive with the rapidity of the Greenland whale, taking out forty fathoms of line. These 'schools' are not all of one sex, as stated by Scoresby, but males and females mixed. The use of the tusk has long been a matter of dispute: it has been supposed to use it to stir up its food from the bottom; but in such a case the female would be sadly at a loss. They seem to fight with them; for it is rarely that an unbroken one is got, and occasionally one may be got with the point of another jammed into the broken place, where the tusk is young enough to be hollow, or is broken near enough to the skull. Fabricius thought that it was to keep the holes open in the ice during the winter; and the following occurrence seems to support this view:—In April, 1860, a Greenlander was travelling along the ice in the vicinity of Christianshaab, and discovered one of these open spaces in the ice, which, even in the most severe winters, remain open. In this hole hundreds of narwhals and white whales were protruding their heads to breathe, no other place presenting itself for miles around. It was described to me as an Arctic Black Hole of Calcutta, in the eagerness of the animals to keep at the place. Hundreds of Eskimo and Danes resorted thither with their dogs and sledges, and while one shot the animal, another harpooned it, to prevent its being pushed aside by the anxious crowd of breathers. Dozens of both narwhals and white whales were killed, but many were lost before they were got home, the ice breaking up soon after. In the ensuing summer, the natives found many washed up in the bays and inlets around. Fabricius describes a similar scene. Neither the narwhal nor the white whale are timid animals, but will approach close to, and gambol for hours in the immediate vicinity of the ship. The range and migration of the narwhal is much the same as that of the white whale. It is only found on the coast of Danish Greenland during the spring and winter, migrating northward and westward in the summer. It is rarely seen south of 65° N. lat. The oil is highly esteemed, and the flesh is very palatable. The skin of the narwhal boiled to a jelly is looked upon, and justly so, as one of the prime dainties of a Greenlander. The hospitable Danish ladies resident in that country make a point of presenting a dish of *mattak* to their foreign visitors, who soon begin to like it."


THE COMMON PORPOISE (*Phocœna communis*).

The second sub-family is that of Delphininæ, and it contains the true Dolphins, the Porpoises, and the Grampus. There are said to be nearly one hundred species known.

Here we can only mention the Dolphin (*Delphinus delphis*), found in the Mediterranean, believed to be the dolphin of the ancients, of which they have given so many wonderful accounts, amongst which the myth of Ario holds a distinguished place.

The Common Porpoise (*Phocœna communis*) is often called the Sea Pig or Herring Hog by the English fisherman. This is the commonest of the Cetacea, being found in all the seas of Europe, in the Atlantic Ocean, and in the Mediterranean. In fact, no one can pass even a few days at the sea-side without seeing a number of these animals sporting in the water. They are gregarious, generally going in "schools," as it is termed, of various numbers, from three or four up to several hundred. When the sea is smooth, they are often seen to spring out of the water, as if in amusement. Their food is chiefly fish, which they pursue with rapidity and voracity, and are in consequence much dreaded by fishermen, whose nets they break, and whose prey they frighten away.

The Grampus (*Orca gladiator*). The Ardluk, or Grampus, is only seen in the summer time along the whole coast of Greenland. Wherever the white whale, the right whale, or the seals are found, there is also this ruthless enemy of theirs. The white whale and seals often run ashore in terror of this cetacean; and seals spring out of the water when pursued by it. The whalers hate to see it, for its arrival is the signal for every whale to leave that portion of the sea. It is said that it will not go among ice, and that the right whale, when attacked by it, keeps among ice to escape its persecution. Occasionally the ends of the laminæ of whalebone are found bitten off by it; and probably this is the origin of the story that it preys on the tongue of the whale. Linné very happily styles it "Balaenarum phocarumque tyrannus quas turmatim aggreditur." Though subsisting chiefly on large fishes, they will not hesitate to attack the largest whalebone whales, and are able to swallow whole large porpoises and seals. Dr. Eschricht took out of the stomach of one thirteen porpoises and fourteen seals, the voracious animal having been choked by the skin of the fifteenth. It has been known to swallow four seals at least immediately one after the other, and in the course of a few days as many as twenty-seven individuals; and they have attacked a white-painted herring-boat in the western islands, probably mistaking it for a Beluga!

Risso's Grampus (*Grampus griseus*) is found in the Mediterranean and Atlantic.

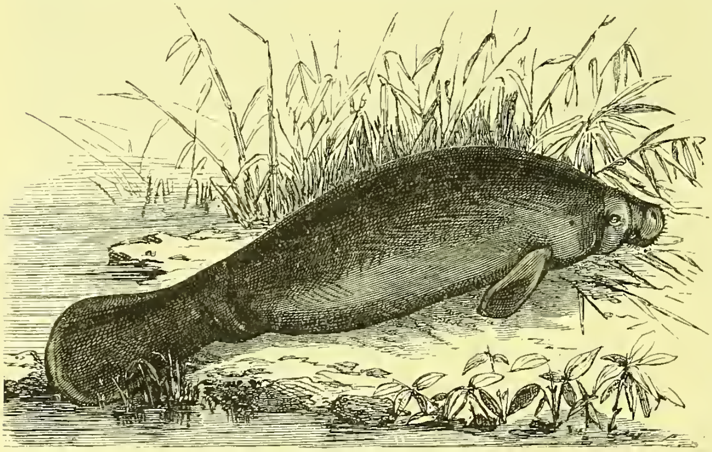
The Bottle-nosed, or Caaing Whale (*Globiocephalus svineval*), is sometimes to be met with in winter on our coasts.

ORDER VI.—THE SEA COWS (*Sirenia*).

THIS small order contains but a single family—that of the Sea Cows. These are aquatic animals living on the coasts, or in one or two of the great rivers of several parts of the world. The nostrils open in the upper lip, at the anterior part of the head; the molar teeth have either flat crowns, or a horny lamella takes their place; the hind limbs are absent; the body is furnished with a few scattered hairs, especially in young individuals. All are vegetable-feeders, living on aquatic plants, especially algæ.

FAMILY XLII.—MANATIDÆ.

Of the three genera contained in this family there is, unfortunately, too good reason to fear that one is extinct. Rhytina stelleri was discovered and described by Steller. It abounded on the island called after Behring on the coast of Kamtchatka; it is described as having attained a length of twenty-four feet. This large marine animal has, as is well known, now quite disappeared from Behring's Island, and even the date (1768) of the destruction of the last individual of the race has been ascertained with exactness. The original account of the Northern Sea Cow by Steller, which was published at Petersburg in 1751, long remained our only authority on the subject. In 1849 Professor Brandt published, in the "Memoirs of the Academy of St. Petersburg," a treatise, in which a complete history of the Rhytina, including all that was known of its structure and habits, and a full discussion of its place in the natural system, is given.



THE DUGONG (*Halicore dugong*).

Of the genus Manatus there are two species. M. americanus is found on the coasts of South America from Florida, to North Brazil, and it ascends the River Amazon far into the interior of the continent. Although praiseworthy attempts have been made to introduce it to Europe, we believe all such up to the present have failed. One captured at Porto Rico in 1866 died on the voyage to England, and another captured by Herr Kassler, of Surinam, in the Maroni River, was brought by Mr. Clarence Bartlett as far as within two days' sail of Southampton, when it, too, died. The second species (*M. senegalensis*) occurs on the west tropical coast of Africa. A most elaborate memoir on the anatomy of the former species by Dr. Murie, will be found in the "Transactions of the Zoological Society of London" (vol. viii., part 3), where figures of this strange animal from photographs are given.

The Dugong (*Halicore dugong*) is found in the Indian Ocean, extending from Mozambique up to, and living in the Red Sea, stretching across to Ceylon, the Malay Islands and to the north coast of Australia. Lequet writes of this animal as common in the Mauritius in the days of the Dodo. It is still found on the east coast of Australia in considerable numbers, though it is rapidly decreasing, as the blacks prefer the flesh and blubber to any other food. Its oil has qualities similar to those of cod-liver oil, having been used successfully in some cases of consumption. The native name for the dugong is "Yungan." It is about nine or ten feet long when full grown, and contains from five to eight gallons of oil. It feeds on seaweed growing on large flats exposed at low water.

ORDER VII.—THE HOOFED ANIMALS (*Ungulata*).

This order contains all the well-known hoofed animals, with the exception of the Elephants and the Hyraces, which from peculiarities in their structure must be regarded as forming orders by themselves. The feet are furnished with one, three, four, or five toes. The molar teeth in both jaws are formed for trituration. The incisor and canine teeth are sometimes wanting. In some, the stomach is simple ; in others, it is compound, and all are herbivorous. Cuvier first proposed to distinguish these hoofed animals according to the odd or even number of their toes, and though this arrangement has often been found fault with, and for the time superseded, yet it appears a highly convenient one, and separates the Horses, Tapirs, and Rhinoceroses from the Hippopotami, Swine, Camels, Deer, and hollow-horned ruminants like the Cow. We commence with the

SUB-ORDER I.—PERISSODACTYLA.

This sub-order of the odd-toed, hoofed animals is divided into three families, all of which contain forms with which we are familiar. It will be well to remember that it is the hind feet that have always the odd number (one or three) of toes, for the fore-feet have sometimes an even number. In the cases where horns occur these are, whether one or two, placed in the middle of the head, and are purely tegumentary organs, composed of fibres of hair-like form closely compacted.

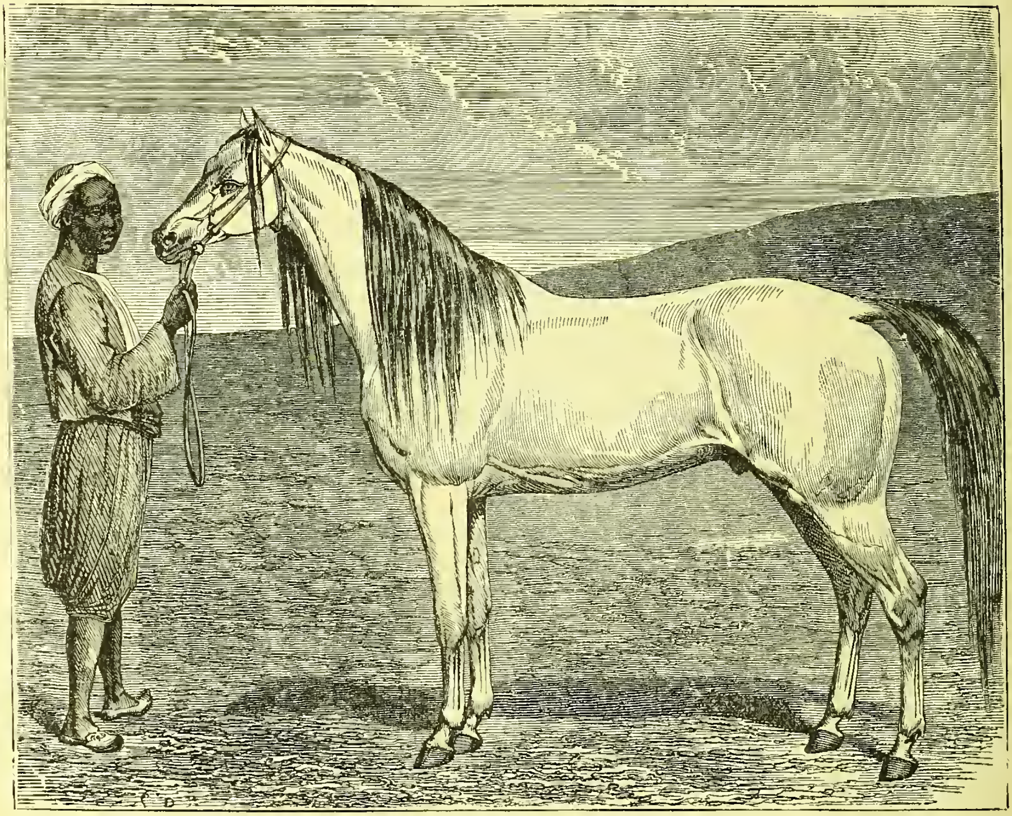
FAMILY XLIII.—THE HORSES (*Equidæ*).

Of this family but one genus is recognised. The single perfect toe on which the species stands is covered by a broad hoof, and there are no supplementary hoofs. The incisor teeth form a continuous series in both jaws. Canine teeth are present in both jaws. The molar teeth are six on either side in each jaw in adults ; in the young animal there is a small anterior molar (wolf tooth) which is deciduous. The horses, asses, and zebras form a group belonging to the Old World. They live in troops, are swift, and feed chiefly on grasses.

The Horse (*Equus caballus*) has the tail hairy throughout. It is no longer met with in its original wild state, though it has returned almost to that condition in the steppes of Asia and in the immense plains of South America. As our space quite forbids us entering upon the natural history of the genus Equus—a history of immense interest, but requiring to be discussed at great length—we can only in the briefest way remind the reader that from the remains of the horse found in tertiary deposits there can be no doubt that he existed many ages ago, and contemporaneously with the great extinct Pachyderms. Some look to Asia as its birthplace, and infer even that the horse of south-western Asia came already domesticated from the north-eastern part. We find no mention of it in the history of the Jews, until we read that Joseph, when bringing the remains of his old father from the banks of the Nile to the cave of Machpelah, was accompanied by horses and chariots; and that they were not very numerous some time afterwards, when the Egyptians took all the chariots of Egypt to pursue the children of Israel with, may be presumed from the number being only 1,200. For a long time the Israelites neither kept nor bred horses, but they seem to have been more or less used by their Canaanitish enemies. There can be little doubt that the horse was an importation from the north-east into Arabia. In early days, the Arab rode on swift camels, and probably learnt first of the horse from some Scythic conqueror.

The Persians were among the first of nations to use the horse in battle, and those of the north made it a type of the sun. Most of the solar and year gods had sacred horses which drew the idol's chariot, or were led before his shrine, and it would seem as if even some of the kings of Judah fell into such practices, for Josiah, we are told, "took away the horses that the kings of Judah had given to the sun ;" and it would seem as if from the Ganges to the Baltic there could have been at one time found, in connection with the sacred groves, stalls for the sacred horses. The Egyptians seem to have paid more attention to improving the breeds of horses than of dogs. They scarcely ever used them for riding, and horses are, in all truly authentic Egyptian pictures, represented as harnessed to chariots. The Homeric heroes of the "Iliad," the Persian and the Babylonian warriors likewise, had these warlike vehicles.

The Bedouin Arab tribes appear early in history as riders of horses, and well-trained chargers gave in after times wings to the sword of Islam, and helped to plant its victorious banners near the slopes of the Pyrenees and on the banks of the Ganges. If it be to Persia, Arabia, and Egypt that we owe all our improved races of horses, it is still to the north of Asia that we must look to find horses forming a part of the very life of the people, as Colonel Hamilton Smith, to whom we are indebted for the material of this *résumé,* says: "There the whole people were mounted; nearly all their domestic work was done in the saddle; rivers were crossed by holding their horses' tails or fastening them to rafts. Of all the races of man, these alone eat horse-flesh, drink mares' milk, and know how to convert it into an intoxicating beverage. They were married on horseback, their councils met on horseback, and declarations of war or treaties of peace were dated from the stirrup."



THE ARAB HORSE.

The natives of north Asia, too, were the inventors of the bridle, of the true saddle, of the stirrup, and possibly of the horseshoe.

It is noteworthy that the author of the Book of Job (xxxix. 19—25) gives the following wonderful description of the horse :—

> "19 Hast thou given the horse strength? hast thou clothed his neck with thunder?
> "20 Canst thou make him afraid as a grasshopper? the glory of his nostrils is terrible.
> "21 He paweth in the valley, and rejoiceth in his strength: he goeth on to meet the armed men.
> "22 He mocketh at fear, and is not affrighted; neither turneth he back from the sword.
> "23 The quiver rattleth against him, the glittering spear and the shield.
> "24 He swalloweth the ground with fierceness and rage: neither believeth he that it is the sound of the trumpet.
> "25 He saith among the trumpets, Ha, ha; and he smelleth the battle afar off, the thunder of the captains, and the shouting"—

which it is probable that he took from a horse with a flowing mane, such as were possessed by the Scythians, and not from an Egyptian war-horse, which is always depicted with a short mane. The people of Arabia believe the horse to be endowed with a nature superior, not in degree only, but in kind, to that of other animals, and to have been framed by the Almighty with a special regard to the convenience of man, and the setting forth of his person. It is one of their old proverbs, that, after man, the most eminent creature is the horse; the best employment is that of rearing it; the most delightful posture is that of sitting on its back; and the most meritorious of domestic actions is that of feeding it. Mahomet himself did not disdain to inculcate a lesson of kindness towards the horse. "As many grains of barley," said he, "as are contained in the food we give to a horse, so many indulgences do we daily gain by giving it." The belief is widely spread that the best breeds are descended from five favourite mares of the prophet, on which he and his friends fled from Mecca to Medina.

Almost every man in Arabia has his horse, not for burden, but for his own pleasure and convenience. His only dwelling is his tent, and there the animal resides like a member of the family. During the day, it is generally kept saddled at the door, ready to start on any excursion which its master may desire to take. It is provided with shoes of soft, flexible iron, hammered cold, and very small, that the swiftness may not be impeded. The saddle is of wood, covered with leather, and the stirrups are short, so as to admit of the rider occasionally standing considerably removed above the horse's back. The Arab uses no stimulant. A slight pressure will make the animal fly like the wind; and if, in the midst of his career, the rider should fall off, the horse will stop till he is re-mounted. By night the horse sleeps amidst the family, whom it takes care never to hurt, and who caress it as they would a favourite among themselves. Kept from food by day, it is regaled at night with a nose-bag full of barley, which is removed in the morning.

Space will not allow us to touch on the subject of the wild horse of Asia, or of that of America. Of the so-called races, there are from the bay stock a countless number, which have spread with the Islam conquests east and west. This stock is now established in England, America, and Australia. From it there are the Arabian race, the Barb of Morocco, the Dongola race, the Turkish race, the Persian, the East Indian race, the English breeds. The white or grey stock is now wonderfully crossed. The black stock is generally spread over Europe, and from it we have the draught horse and horses of a large stature. From the dun or tan stock we have the Shetland and Galloway ponies and the horses of the Ardennes.

The Ass (*Eq. asinus*) was long used for the saddle in the Oriental regions; and persons of high rank appeared in public mounted on this animal. Those which the great and wealthy selected for use were large and elegant animals. Thus, travellers describe a variety of the ass in Syria, much larger than the common breed. Some of them, in Persia, are kept like horses for the saddle. These have smooth hair, carry their heads well, and are quicker in their motions than the ordinary kind. They are caparisoned like horses, and taught to amble like them. Tavernier says that fine asses are sold in Persia dearer than horses, "even to an hundred crowns each." In Egypt, also, these animals are often handsome, and are used for riding by the Mohammedans, and by the most distinguished women of that country.

The hotels of Cairo are still beset with donkeys and their drivers. The animals are indispensable, for almost no one thinks of walking many yards in Egypt. In the middle of the day the heat forbids it, as well as the mud, dust, and crowds of people riding and on foot. As soon as the visitor appears at the door, some two or three dozen drivers and their donkeys bear down upon him. Every voice rises to its highest pitch, blending the sounds: "Berry good donkey, master;" "Berry handsome donkey;" "Dis your donkey, master;" "Had dis donkey before, master;" "Donkey fall down? Oh, no, master! Go like steamer."

The Romans had a breed so highly esteemed, that Pliny mentions one of the stallions selling for a price exceeding £3,000 of our money; and he says that in Celtiberia, a province of Spain, a she-ass has brought colts that were bought for nearly the same sum. Varro also speaks of an ass that was sold in his own time, in Rome, for nearly £500. In Spain the asses became, by care and attention, large, strong, elegant, and stately animals, and often rising to fifteen hands high. The best of them sold sometimes for a hundred guineas each and upwards.

The ass, like the horse, was imported into America by the Spaniards. That country seems to be peculiarly favourable to this race of animals, for where they have run wild they have increased immensely.

As the milk of the female ass contains much saccharine matter, and little butter, it can be digested by tender stomachs, unable to assimilate the richer milk of the cow. Of its service to persons of delicate habits there can be no doubt, and Dr. Wolcot (Peter Pindar) only called it in question when recommended by Dr. Geach, for the purpose of despatching the following epigram:—

"And, doctor, do you really think
That ass's milk I ought to drink?
'Twould quite remove my cough, you say,
And drive my old complaints away.
It cured yourself—I grant it true—
But then, 'twas *mother's milk to you!*"

CAIRO DONKEY AND DRIVER.

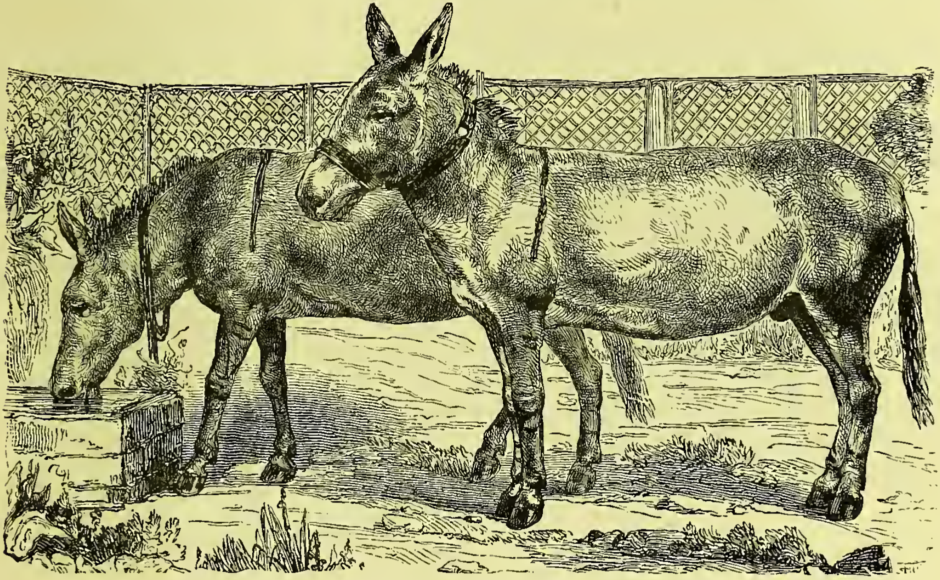
The offspring of a horse and an ass is called a mule; that of a mare with an ass is called a hinny.

The Wild Ass (*Eq. onager*) lives in large troops in Tartary, and moves during winter to more southern regions. To the passion of the Persians for hunting so wild an animal that country owed the loss of one of its most estimable sovereigns, Baharam the Fifth. The catastrophe, which occurred fourteen hundred years ago, forms a romantic tale, which the people still relate to the passing traveller. It is as follows:—"The ruling passion of Baharam was the love of the chase. His favourite game was the *gour*, or wild ass, which is both strong and fleet, and it was in pursuit of one of these that he lost his life, having suddenly come upon a deep pool into which his horse plunged, and neither the animal nor his royal rider were seen again. This accident happened in a fine valley between Shiráz and Isfahán, which to this day is called the Vale of Hervis, from being (on account of its fine pasture and abundance of game) the favourite resort, from the earliest ages, of the kings and nobles of Persia. The whole of this valley abounds in springs, some of which are very large, and of great depth; their sources underground are supposed to communicate. It is not surprising, therefore, that the body of Baharam was never found, although every search was made for it by his inconsolable mother."

The subjugation of the wild ass when young is often accomplished at the present time by the Arabs of Mesopotamia. Mr. Layard states that the foals are of a light fawn colour, almost pink; that the Arabs sometimes catch them during spring, and bring them up with milk in their tents. He endeavoured, in vain, to obtain a pair. The Arabs eat their flesh.

The Keang (*Eq. hemionus*) is often called the wild ass of Tibet. The following account of the specimen in the Zoological Gardens in London is by Major W. E. Hay:—

"The animal I now make over to the Society was an exchange present with the Zông-pûn, or Chinese Governor of Kûdôk, a hill fort situated beyond the Pâng-Kông Lake in Little Tibet. I had sent up from Kûllû to procure two dogs of enormous size, evidently of the same breed as was described by Marco Polo as being of the size of donkeys. One of these, however, had died, and the person deputed, thinking I should prefer a wild horse to a single dog, secured it for me. At that time it had never been haltered or handled. It was said to have been caught in a pit, and was much attached to a white Chûmûrti ghoont, which alone it would follow. In December, 1857, it was delivered to me in Kûllû, but the white ghoont being claimed by a Tibetan llama, I purchased a Tibetan mule to keep it company. With this it did not agree, and the mule led anything but a happy life. The kiang would, however, follow it, and was always restless unless it had some horse in company. Of colours, its preference was for white. It always showed the greatest aversion to pass over any of our vile wooden bridges; and when its companion passed over the bridge, waited until it saw that the latter had gained the opposite bank, and then, in a fearless manner, it would plunge into the most rapid stream, and usually made nearly a straight course across. In leaving Kûllû to take it to Simla, it had to cross the river Biass, which was at that season a foaming torrent. It plunged in, but was carried down the stream several hundred yards, and landed upon an island. Here it remained quietly all night until the following morning, when I had to send the mule across to the island to tempt it to follow to the shore, which it did. It afterwards crossed a broad part of the river with great ease, where it was less rapid. The Sutlej was at this season so full, and running at such a frightful pace, that I deemed it advisable to throw the animal and secure it upon a raft, which was with great difficulty got across. I then brought it into Simla, where it gradually became accustomed to see more people and (to it) strange sights. I kept it there during the whole of one rainy season, although rather doubtful of the result, since Adolph Schlagintweit had given it as his decided opinion that the animal could not live under an elevation of 10,000 feet above the level of the sea. At Simla it was never a day sick. I thence had it marched to Ferozepore. On reaching the plains it seemed rather inclined to enjoy freedom, and I was obliged to have as many as four men to hold and lead it, and even then on several occasions it got away, but it was not very difficult to secure it again. After keeping it a month at Kurachi, I took a passage in the barque *Sumner*, laying in a large quantity of hay, kirbee, and dried lucerne, also grain. The latter was worm-eaten, and it was long before the animal could be induced to touch it. Our passage was very long, and, the captain's people having unceremoniously used my provisions


THE ASS (*Equus hemionus*. In the Jardin des Plantes, Paris).

to feed their own stock, the kiang was twice reduced to eat the straw with which the sailors' bedding had been stuffed. This proves the hardiness of the animal. At first it refused to drink any tainted water; but before reaching St. Helena, where I had to lay in fresh supplies, it would eat or drink almost anything. I always found the kiang very susceptible of kindness, its satisfaction being usually expressed by throwing its ears forward. It generally shows a sort of pettish displeasure when any one is leaving it after giving it bread, &c. I twice placed a native of India on its back, but this was after it had gone a march, when it was slightly distressed by the heat of the weather. It took no notice whatever of its rider. I was convinced of the kiang's specific difference from the wild ass of Scinde when I saw one of the latter at Delhi, intended for conveyance to England; and this made me persevere the more to get it home. I have often watched the herds of this animal on the plains or slopes of hills in Tibet. One invariably stands sentry at from 100 to 200 yards from the flock, and when danger is at hand, he commences walking leisurely towards his companions. They take the alarm, and as soon as he comes up, off all go together in a trot or canter as the case may require, I don't know to what space to limit the range of the kiang. Marco Polo speaks of asses, but evidently alludes to those of Persia. Huc and Gabet evidently saw them towards Lassa; and I have been told they are to be met with on all the level country between Ladak and Lassa, or in the valleys between the various ranges. I have seen them only north of the great Himalayan ranges, first upon the Rupcher plains, and in the neighbourhood of the Salt Lakes, often in company with the Nyan (*Ovis ammon*). I have also seen them north of the Pâng-Kông Lake. The passes from Hindustan into Tibet are never open before June, when I have seen flocks of the kiang feeding almost entirely on the roots of a species of Artemisia, or wormwood. Their natural enemies besides man seemed to be a white panther, which lurks amongst the rocks, and a large species of wolf. I have found their skeletons on the melting of the snow. Beyond the Pâng-kông Lake I was informed that in winter many of them were to be seen in the Shap-Yok Valley, in company with wild yâks, or dông, also the Nyan (*Ovis ammon*), and the Sûs or Tibetan antelope (*Panthalops Hodgsoni*). A few tamarisk bushes seemed then to support them, and at the end of winter all these animals are spoken of as being like walking skeletons. I have sometimes approached flocks of kiang quite close, at other times could not get within a mile of them. On one occasion two kiangs followed a pony on which I had a servant mounted, in fact, kept so close that my servant feared they were going to attack him. When very young, the hair of the foal has the appearance of wool. The winter coat of the adult is also very thick and curly, and is of darker colour than its summer coat. It appears to shed its winter coat in May. The kiang may be said to inhabit plains and undulating hills, at from 15,000 to 16,500 feet above the sea; if found in the steeper hills they have been driven there. It is most wonderful to see the rapidity with which they can ascend mountains, and although they descend quickly, I never saw one lose its footing. After they have been pursued for some time on the hills and driven on to the plains, they will frequently make a charge past you about 100 yards distance in preference to ascending the steep parts again, thus showing their preference for level ground. They are almost always seen near lakes or ponds in the unfrequented spots which are usually beyond the sportsman's beat."

THE ZEBRA (*Equus zebra*).

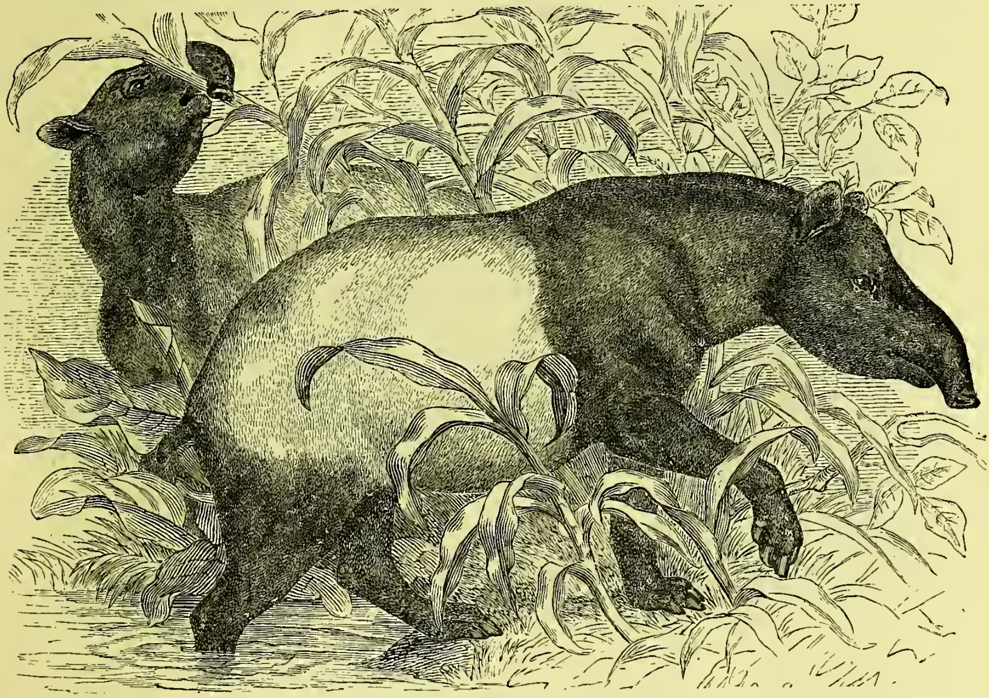
The Zebras are peculiar to South Central Africa. The best known is the Zebra (*Eq. zebra*). It is striped black and white, and has rings of black and white on its legs. The Quagga (*Eq. quagga*) is brown, with black stripes; the belly and legs are white. Burchell's Zebra (*Eq. Burchellii*) is striped like the zebra, but has white legs.

FAMILY XLIV.—THE TAPIRS (*Tapiridæ*).

The Tapirs have the nose produced into a small mobile proboscis. Incisor, canine, and molar teeth are found in both jaws. The anterior feet are three or four-toed, but the posterior are three-toed ; each toe has a separate hoof, and all reach to the ground. The neck is short, and the tail is very short. There are two genera, and six species. All, except one, of the known species are found in Central and South America.

The Brazilian Tapir (*Tapirus terrestris*) is found in woods and moist places on the banks of rivers in Brazil, also in Berbice and Demerara.

The short proboscis of this creature, though incapable of being employed like that of the elephant, is yet manifestly of great use in enabling it to pull down boughs or fruits, and to collect together and guide to its mouth roots, succulent plants, or other substances on which it feeds. Lieutenant Maw speaks of a young tapir which he brought to England as going much into the water, in which, like the elephant and the rhinoceros, it takes great delight, swimming and rolling about to enjoy the refreshing luxury of the bath.



THE INDIAN TAPIR (*T. sumatranus*).

The sight, hearing, and smell of the tapir are very acute. It is much in request among the natives for its flesh, which, though coarse and dry, they regard as excellent food. The skin is valuable from its toughness and density.

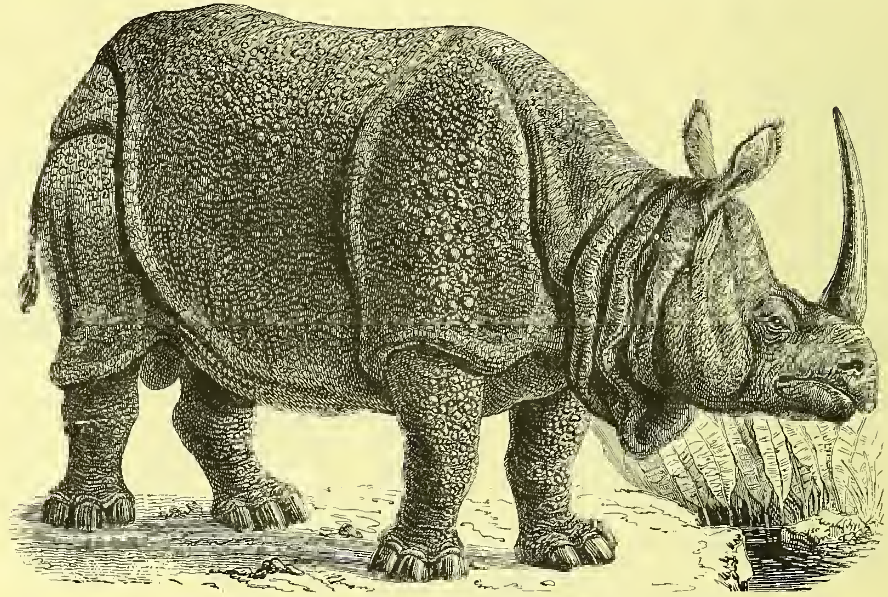
In some parts of South America the tapir is domesticated. M. Sonnini saw numerous individuals walking at liberty about the streets of Cayenne, whence they were accustomed to stroll into the neighbouring woods, returning at night to their home ; nor were they by any means destitute of intelligence, but seemed fond of their masters, whom they acknowledged by various tokens of attachment.

Tapirus pinchacus is found in the Cordilleras. T. sumatranus occurs in Sumatra, Borneo, and Malacca. It is sometimes called the Indian Tapir.

Elasmognathus Bairdii has been recently described by Professor Gill. It appears to be the only species of the genus inhabiting the Isthmus of Panama, and has only been found on the Atlantic side of the isthmus, and north of the Chagres River. Its favourite haunts appear to be on the hills lying at the back of Sion Hill and the adjoining stations of the Panama railroad. It is only during the rainy season that they seem to seek the lowlands. This species is figured in the "Zoological Society's Proceedings" for 1871.

FAMILY XLV.—THE RHINOCEROSES (*Rhinocerotidæ*).

The rhinoceroses are heavy animals, with a long head and short tail. They live in the warmest regions of the Old World, being met with in Asia and Africa. Their upper lip is prehensile. The incisor teeth of the upper jaw are either rudimentary or wanting, and those of the lower jaw are unequal, sometimes the outer ones projecting. There are no canines. The toes are three in number; all are nearly of the same length, more or less free, and all touch the ground. The skin is thick, thinly haired, often divided into great folds. They have a single horn, or two horns placed one behind the other, on the middle of the muzzle and forehead. Dr. Gray separates the Asiatic from the African species, and makes four genera. We shall select a species out of each genus.



THE INDIAN RHINOCEROS (*R. unicornis*).

The Indian Rhinoceros (*Rhinoceros unicornis*). This animal leads a tranquil, indolent life in his native regions. Like the elephant, he prefers the marshy borders of lakes and rivers, or swampy woods and jungles, delighting to roll and wallow in the oozy soil, and plaster his skin with mud. Habitually sluggish in his movements, the rhinoceros wanders through his native plains with a heavy step, carrying his huge head so low that his nose almost touches the ground, and stopping at intervals to crop some favourite plant, or, in wanton play, to plough up the ground with his horn, throwing the mud and stones behind him. When roused, he is a most formidable antagonist, and, such is the keenness of his senses of hearing and smell, that, unless you very cautiously approach him against the direction of the wind, it is almost impossible to take him by surprise. On the appearance of danger he generally retreats to his covert in the tangled and almost impenetrable jungle, but not always, and instances are recorded in which, sniffing up the air and throwing his head violently about, he has rushed with fury to the attack. There are, in fact, seasons in which the rhinoceros is very dangerous, and impetuously attacks every animal that attracts his notice, or ventures near his haunts, even the elephant himself.

The strong, deep folds into which the coarse skin is gathered upon the cheeks, neck, shoulders, haunches, and thighs, are distinguishing marks of the Asiatic rhinoceroses.

The general colour of the skin of this species is dusky-black, with a slight tint of purple. Mr. Hodgson states that the female goes from seventeen to eighteen months with young, and produces one at a birth. He adds also, "It is believed that the animal lives for a hundred years; one taken of full size was kept at Katmandoo for thirty-five years without exhibiting any symptoms of decline. The young continues to suck for nearly two years. It has, for a month after birth, a pink suffusion over the dark colour proper to the mature hide." Bishop Heber saw several of these animals at Lucknow, and remarked, "These are quiet, gentle animals, except that one of them has a feud with horses. . . . . I should conceive that they might be available to carry burdens as well as the elephant, except that as their pace is still slower than his, their use could only be applicable to very great weights, and very gentle travelling." In another passage he says, "In passing through the city I saw two very fine hunting-tigers, in silver chains, and a rhinoceros (the present of Lord Amherst to the Guicwar), which is so tame as to be ridden by a mahout—quite as patiently as an elephant."

The Sumatran Rhinoceros (*Ceratorhinus sumatranus*). Blyth mentions that the horns of this species are exceedingly difficult to procure; they are eagerly bought up at high prices by the Chinese, who not only value them as medicine, but carve them into very elegant ornaments. The front horn in this species is longer than the hind one, and is curved backwards. The smaller horn is conical.

It does not appear that as yet any living specimens of the African rhinoceroses have been brought alive to Europe; so that we are indebted to Dr. Andrew Smith's excellent figures in his illustrations of South African zoology for a knowledge of their appearance as seen in life. The Keitloa (*Rhinaster keitloa*) is well known to all readers of African travel. It lives in herds—is a "browser," feeding on leaves and young shoots of trees. It frequents forest and bush country, avoiding grassy plains. It is of a very savage disposition, and seldom ranges higher than about 25° south latitude. The Borili (*Rhinaster bicornis*) has been well known to the colonists of the Cape of Good Hope ever since 1652. In that year, when the Dutch first formed their settlement on the shores of Table Bay, this animal was a regular inhabitant of the thickets which clothed the slopes of Table Mountain. It feeds upon brushwood and the smaller branches of trees. It is a moderate eater, and is not so fierce a character as the keitloa.

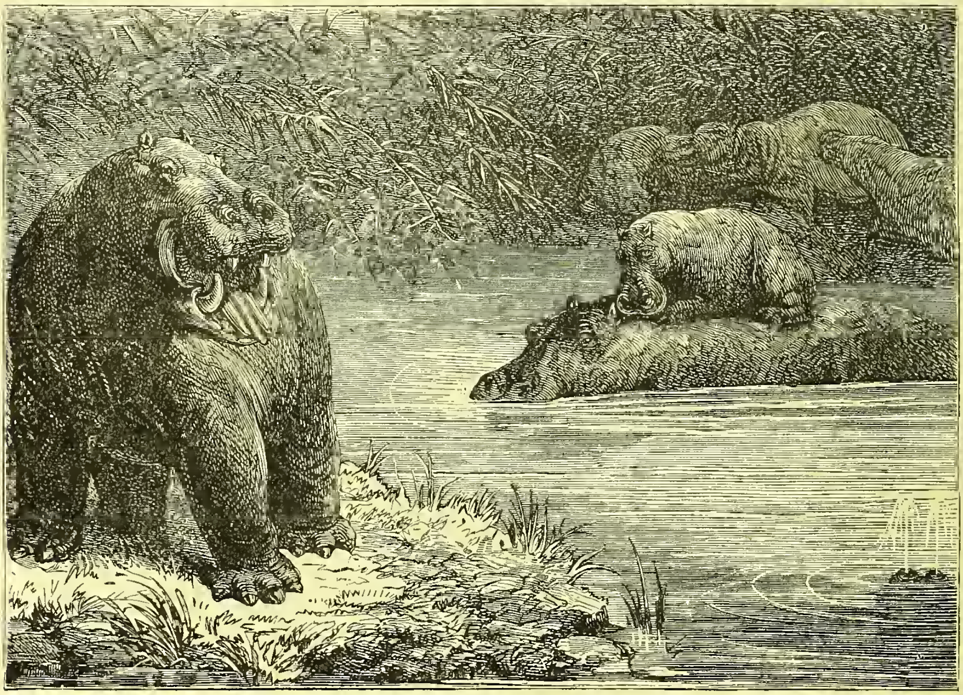
The Mahoohoo (*Ceratotherium simum*) is found in South and Central Africa. Unlike the former species, this rhinoceros is a "grazer." It is gentle, living in open plains where it can get grass. It is the first animal that disappears before firearms, and is, as Dr. A. Smith predicted, becoming scarce. The nose is truncated, and the mouth is shaped like that of the ox; the nostrils being small, and opening externally. It is called by the Bechuanans, Mahoohoo, and is considered by them to be one of the original animals of their country, and to have issued from the same cave out of which their own forefather did. In this respect they make a difference between it and the keitloa, with whose origin they do not profess to be acquainted. The peculiar configuration of the mouth will easily distinguish this from all the other rhinoceroses. Localities abounding in grass are the haunts of this species, and to find these he is obliged to lead a more wandering life than the others. The Rev. John Campbell evidently refers to the same species. He says:—"The rhinoceroses shot by Jager on the preceding day, being cut up, were brought, the one in a wagon, the other on pack-oxen. . . . The common African rhinoceros has a crooked horn, resembling a cock's spur, which rises about nine or ten inches above the nose, and inclines backwards; immediately behind this is a short, thick horn; but the head they brought had a straight horn, projecting three feet from the forehead, about ten inches above the tip of the nose. . . . . It has a small, thick, horny substance, eight inches long, immediately behind it, which can hardly be observed on the animal at the distance of a hundred yards. . . . . The head resembled in size a nine-gallon cask, and measured three feet from the mouth to the ear, and being much larger than the one with the crooked horn, and which measured eleven feet in total length, the animal itself must have been still larger and more formidable. . . . . The natives, I afterwards heard, made from one horn four handles for their battle-axes."

SUB-ORDER II.—ARTIODACTYLA.

This sub-order embraces the Pigs, Camels, and Hollow-horned Ruminants, all of these being hoofed animals, with an even number of toes. When these have horns, they are never developed singly, but are placed on each side of the median-line of the forehead, in one pair or two. All of them have a complex stomach. The forms will be best seen when we give the families in detail.

FAMILY XLVI.—THE HIPPOPOTAMUS (*Hippopotamidæ*).

This family contains but a single genus, with two species. The feet are short and tetradactylous, with short hoofs. The body is obese, with a nearly naked skin; the tail is short and compressed. The dentition differs from that of the true Pigs, which belong to the following family. The face is wide; mouth very large; the eyes are high on the forehead; the canines are large, projecting, tusk-like, and obliquely worn.



HIPPOPOTAMI (*H amphibius*).

The Hippopotamus (*Hippopotamus amphibius*) either did or does inhabit all the great rivers of Africa. Formerly it was met with as far north as Egypt, now nowhere more northward than Abyssinia; but further south it is found to the Cape of Good Hope.

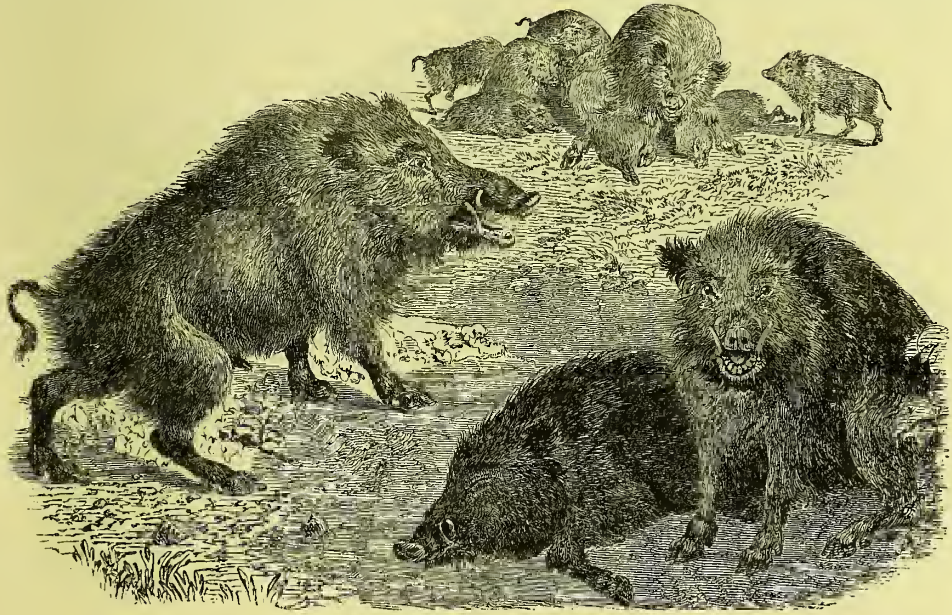
The general colour of the hippopotamus is a dusky brownish-red, passing on the sides and limbs into a light purple, red, or brown; the under parts, the lips, and the eyelids, are light wood-brown, with a tinge of flesh-colour; the hinder quarters and the under surface are freckled with spots of dusky brown; the hairs of the tail and ears are black, those on the muzzle yellowish-brown. The male exceeds the female in size. The hippopotamus is gregarious, wary, and cautious.

These animals, according to Dr. A. Smith, feed chiefly on grass, resorting to situations near the banks of rivers which supply that food. In districts inhabited by man they generally pass the day in the water, and seek their nourishment during the night; but in localities differently circumstanced, they often pass a portion of the day as well as the night on dry land. In countries in which the night-time constitutes the only safe period for leaving the water, they are exceedingly wary. It has several times bred in Europe.

The Liberian Hippopotamus (*H. Liberiensis*) is a much smaller species, from West Africa, first described from Liberia by Mr. Morton. There are fewer incisors in the lower jaw than in the common species, and hence it has by some been placed in a separate genus. A young specimen was brought to the Zoological Gardens of Dublin in 1873, and, dying shortly after its arrival, it afforded Professor Macalister the opportunity of writing an account of its anatomy, which has been published in the "Proceedings of the Royal Irish Academy," Volume i., Series 2.

FAMILY XLVII.—THE PIGS (*Suidæ*).

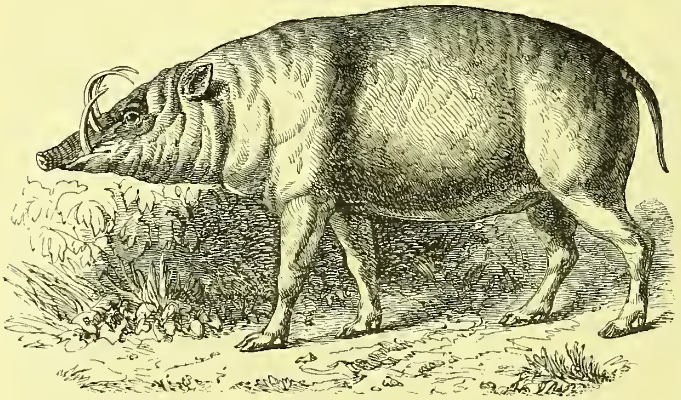
In this family we have the Pigs, Peccaries, and Wart Hogs. These all have the nose truncated, with a cartilaginous mobile nob on the top, over the nostrils, which is used for grubbing up roots. The toes are in pairs; the front ones on each foot large, the posterior pair not reaching the ground. The outer toe is sometimes wanting. All are inclosed in triangular hoofs. The incisor teeth vary in number, but are mostly six in the lower jaw —sometimes more in the upper; the canines in both jaws distinct—large in the male, recurved. This family might be divided into three sub-families—(1), the Suinæ; (2), the Dicotylinæ; and (3), the Phacochœrinæ; the two last containing each one genus, and the first with three genera, which we proceed to mention.



THE WILD BOAR (*Sus scrofa*).

The Common Hog (*Sus scrofa*) is found throughout Europe and in North Africa. It is not easy to decide whether the domestic pig is derived from the wild species. M. Sanson seems to think not, and says that he knows of no exotic species from which it is likely to have been derived. In its native forest the wild boar is a most formidable animal, and, when hard beset, defends himself with great energy and resolution, his strength and tusks rendering him a terrific opponent. The hazardous chase of this animal is still eagerly followed in German and the wooded regions of Europe; and it is also one of the wild sports of the East. The old males are said to live solitarily, never congregating with the general herd, which consists only of females and their young, for which the mothers fight with the utmost fury. The wild boar, however, is easily reclaimed. The importance of the domesticated hog, economically considered, is appreciated by all. In the rearing and feeding of it, and in the preparation of its fat and flesh by the processes of salting and drying, capital to a considerable amount is invested. Its flesh is also used in a fresh state; and there is a general agreement with the epicures of ancient Rome, that a young pig is one of the delicacies of the table. Much of the value of this animal arises from the constitutional predisposition of its race to the production of a layer of fatty tissue between the skin and muscles, which forms lard.

Of English shires, Hampshire and Berkshire are each celebrated for a fine breed, individuals of which often become extraordinarily large. One of the latter breed, killed at Congleton, in Cheshire, is said to have measured, from the nose to the end of the tail, nine feet eight inches, and to have stood four feet and a half in height; its weight, when killed, was 1,215 pounds. We hear of enormous magnitude less frequently since the introduction of the Chinese race. This hog is of small size, with a deep round body, full round haunches, a short, thick neck, erect ears, and a short and abruptly-sharpened snout. The limbs are short, with small bones, and compact toes; the prevailing colour is black, or half black and half white. The flesh is remarkable for its delicacy. This breed, or one closely related to it, extends from China throughout the various groups of islands in the South Pacific. Excellent as the flesh of the Chinese hog is, and of the breeds crossed with it, preference is still given to some of our native breeds, as yielding the best bacon and hams. Of these the Berkshire, Hampshire, Suffolk, and Yorkshire breeds are most highly esteemed. Canon Tristram describes the wild boar as "abundant on the wooded hills and maritime plains of the Holy Land. It swarms in all the thickets by the Jordan and Dead Sea, and in the forest country east of Jordan. It extends even to the bare wilderness of Judæa, and almost into the desert, where there is no cover, and where its only food are the roots of the desert bulbs."


THE BABIROUSSA (*B. alfurus*).

The hogs with tapering ears ending in a pencil of hairs, and found only in Africa, constitute the genus Potamochœrus. The Red River Hog (*P. penicillatus*) is found on the West Coast of Africa. It has been several times brought to England, and has on at least two occasions bred in the London Zoological Gardens. Some years ago it was introduced to Brazil, but we have not been able to learn whether or not the experiment has turned out a success. Another species, the Southern River Hog (*P. africanus*), is called in South Africa "Bosch Vark," and has been met with in Central Africa by Dr. Kirk.

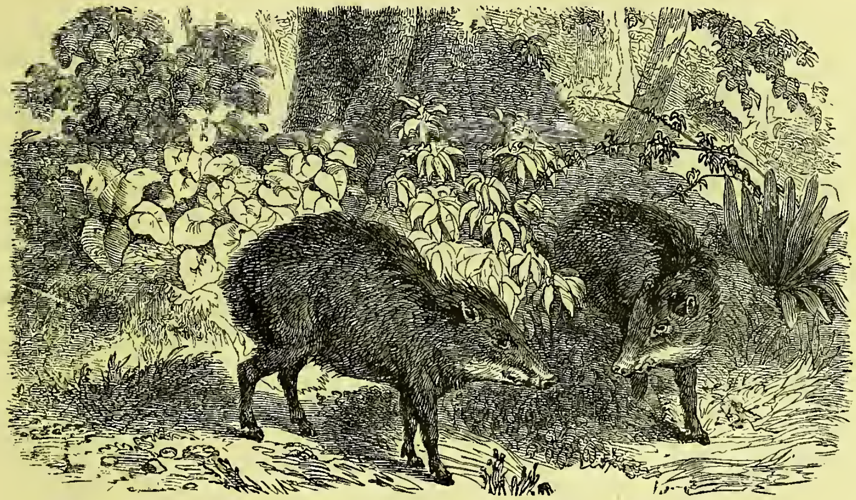
The Babiroussa (*Babirussa alfurus*) belongs to the third genus. The Dutch name of this animal means Stag-hog. There is reason to think that the ancients were not altogether unacquainted with the Babiroussa. Pliny notices a wild boar with horns on the forehead, found in India; and Cosmos, a writer in the sixth century, uses the term hog-deer as the designation of an Indian animal. However this may be, it is only recently that naturalists have become well acquainted with it and its habits, though skulls of these animals have been brought over to Europe in abundance by vessels trading among the Moluccas.

The Babiroussa differs somewhat in dentition from the hog, the incisors being four above, instead of six, and the molars five on each side, in either jaw. The upper canines, or tusks, of the male emerge directly upwards from their apparently distorted sockets, and sweep with a bold arch backwards, attaining to a very great length. The tusks of the lower jaw are long, strong, and sharp, emerging like those of the boar. The skin is thick, coarse, of a blackish tint, and sparingly beset with very short, bristly hairs. The male, when adult, equals the largest hog; the female is of much inferior size, and destitute of the curled upper tusks, or has them only rudimentary.

This animal is found in the marshy forests in the interior of Bouru, and also in Celebes, where it associates in troops. Its habits resemble those of the wild hog, and it is restless and ferocious. According to Lesson, it feeds chiefly on maize, preferring that grain to other articles of diet. It is partial to the water, and swims with the greatest ease, often crossing the straits between adjacent islands without any difficulty.

In a state of captivity, as in the London Zoological Gardens, and the Jardin des Plantes, Paris, this animal seems to be contented. A pair of them, in the latter collection, produced young. They were fond of nestling under the straw, and, when the male retired to rest the female would cover him over with litter, and then creep under the straw to him, so that both were concealed. In the former, a young Babiroussa was not only quiet, but disposed to familiarity, raising itself up on its hind legs, and putting its snout to the bars of the inclosure, evidently soliciting food.

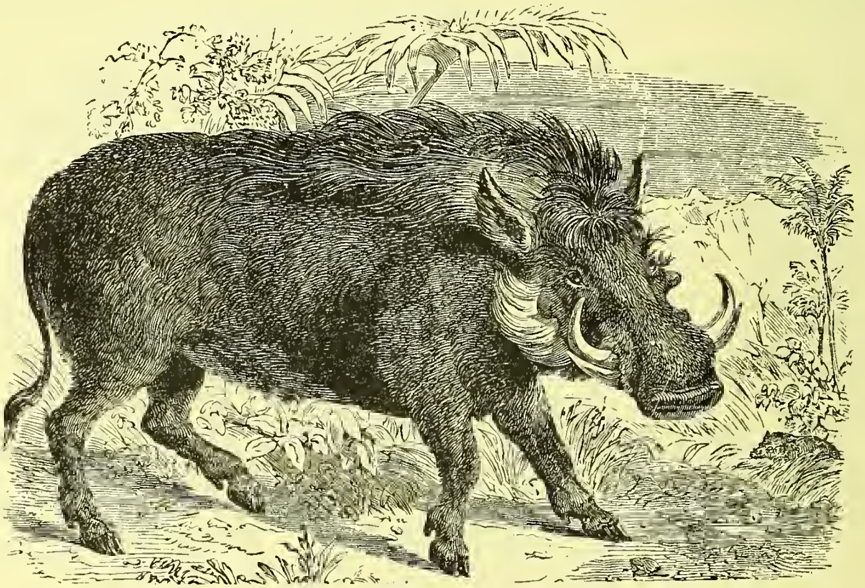
The sub-family Dicotylinæ contains the single genus Dicotyles, and its two species are found in South America. They are the only indigenous representatives of the pigs in the New World, where they are met with only in the tropical regions extending from Mexico to Paraguay on the east coast, but on the west they crop up as far north as the Red River of Arkansas. The Collared Peccary (*D. tajacu*) is usually met with in pairs, or small families. They take up their abode in hollow trees or holes of the earth, where they seek a refuge from the pursuit of their enemies, of which, with the exception of man, the jaguar is the most destructive. Plantations of maize, sugar-cane, and potatoes, often suffer from their incursions. It is only when hard pressed that this peccary defends itself; indeed, it displays nothing of the sullen courage of the wild boar, but retreats on the appearance of danger, and precipitately seeks its hiding-place.



THE WHITE-LIPPED PECCARY (*D. labiatus*).

"It is," says D'Azara, "domesticated with more facility than the wild hog, and becomes troublesome from its familiarity. The collared peccary is about three feet in length, and is distinguished from the next species by a stripe of white, or yellowish-white, passing from the withers down each shoulder, and meeting on the throat. Its general colour is grizzled blackish-grey, the bristles being ringed grey, straw-colour, and black. The hind-feet are tridactylous, and there is a tubercle in place of a tail.

The White-lipped Peccary (*D. labiatus*) congregates in numerous bands, sometimes, it is said, amounting to more than a thousand individuals of all ages. Thus united, they frequently traverse extensive districts, the whole troop occupying an extent of a league in length, and directed in their march, if the accounts of the natives are to be credited, by a leader, who takes his station at the head of the foremost rank. Should they be impeded in their progress by a river, the chief stops for a moment, and then boldly plunges into the stream, and is followed by all the rest of the troop. If they meet with anything unusual in their way, they make a terrific clattering with their teeth, and stop and examine the object of their alarm. When they have ascertained that there is no danger, they continue their route without further delay; but if a huntsman should venture to attack them when they are thus assembled in large numbers, he is sure to be surrounded by multitudes and torn to pieces by their tusks, if he is so unwise as to neglect his only chance of escape, which consists in climbing a tree, and thus getting fairly out of their reach. The smaller bands are by no means equally courageous, and always take to flight at the first attack. In Guiana, Sonnini was surrounded by a herd of peccaries, exasperated at the havoc made among them by the fusils of himself and his companions. Betaking himself to a tree, he beheld at his ease how they encouraged, by their grunts and by rubbing their snouts together, those that were wounded from the shots above, still maintaining their ground with bristles erect and eyes fiery with rage. They stood an incessant fusilade of two or three hours before they quitted the battle-field and left their dead to the conquerors. After such an encounter came the festival of the travellers. A great gridiron—so to speak—of sticks, fastened in the ground, and some three feet in height, with numerous small branches laid on it in a transverse direction, was got ready, and on this sylvan cooking apparatus the pieces of peccary pork are broiled over a slow fire kept up during the night. Sonnini dwells enthusiastically on these forest feasts, to which he always looked back with regret.



THE ABYSSINIAN WART HOG (*Phacochœrus africanus*).

The third sub-family contains the Wart Hogs (*Phacochœrus*), essentially African forms, ranging over its tropical regions, from Abyssinia to Caffraria. Ælian's Wart Hog (*P. africanus*) has the fur of a dull ashy-brown, beneath whitish; ears and beard on cheeks whitish. The great canines are conical, the upper being bent upwards. The head is elongate. It is found on both the west and east coasts of Africa.

This species was found by Rüppell first in Kordofan, but afterwards, in greater abundance, on the eastern slope of Abyssinia. It haunts low bushes and forests, and has a habit of creeping on its bent fore limbs in quest of food. In this attitude it uses its tusks in digging up or tearing out of the ground the roots or plants which constitute part of its diet. When thus engaged it pushes its body forward, by means of its hind legs, in order to move along. This habit has been occasionally noticed in the common pig.

The Æthiopian Wart Hog (*P. æthiopicus*) has the head shorter than in the last species. The cutting teeth in the upper jaw are two, and those in the lower are small and deciduous. The capture of a specimen is thus described by Captain Sir C. Harris:—"Returning one drizzly morning from the banks of the Limpopo, with the spoils of three noble water-bucks packed upon my horse, I chanced upon a very large drove of these unclean beasts, feeding unconcernedly on the slope of a hill; and the sleet obscuring my rifle sights, I projected no fewer than three bullets at the diabolical-looking boar without touching a bristle, the whole party, with a general grunt, scampering off after each discharge to a little distance, then wheeling about to show a menacing front, exalting their whip-lash tails at the same time, and screwing horrible faces at me. But the fourth missive tripped up the hoary general; and, although *shooting a pig* may sound somewhat oddly in the sporting ears of my brother Nimrods, I can assure them that whilst we had no horses to spare, 'the head of that ilk swine' proved a prize well worth the lead and gunpowder that had been expended on it. Gigantic, and protruding like those of an elephant, the upper tusks were sufficiently hooked to admit of the wearer hanging himself up by them to roost, as did his ancestors of yore, if the ancients are to be believed. By all who saw these trophies in the colony, they were invariably taken for the ivories of a *Zeekoe* (Hippopotamus), the best that I afterwards realised measuring less than one-half their length."

FAMILY XLVIII.—THE CAMELS (*Camelidæ*).

The Camels of the Old World and the Llamas of the New World form a very remarkable group, very distinctly separated from the rest of the ruminating animals, not only by the form of their hoofs, but by the possession of cutting teeth in their upper jaw. There are but six incisors in the lower jaw, and this is undivided. The upper lip is cloven, the neck is long, the feet are didactylous, without supplementary hoofs, and there are no horns. Only a very few species (six) are found in this family, and the majority of these are now only to be found in a state of domestication.

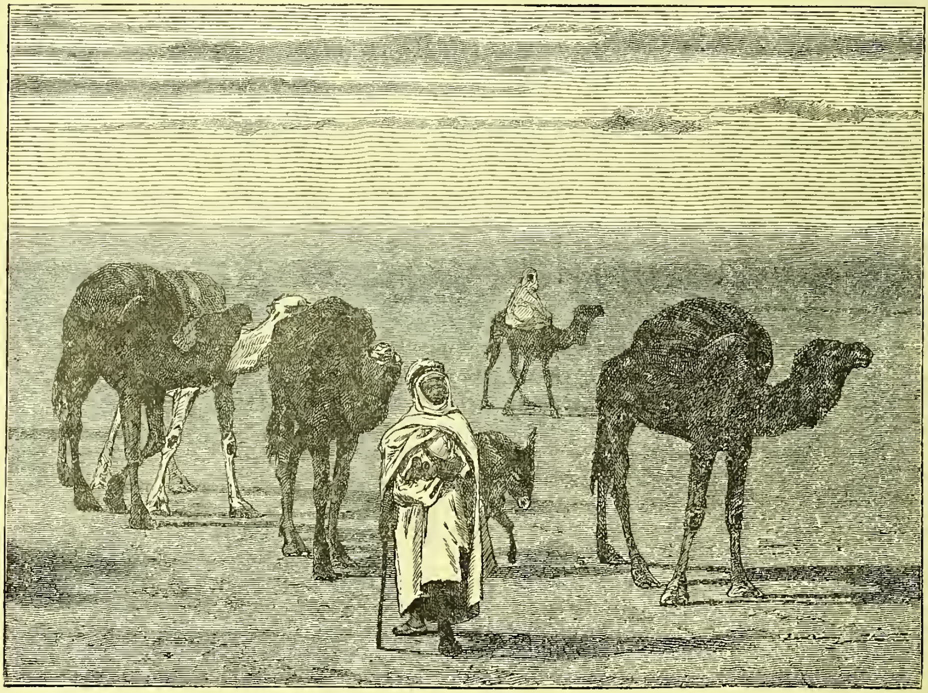
The Camel (*Camelus dromedarius*) is no longer to be found anywhere in the wild state, but is chiefly to be met with in Arabia and Egypt, in the country of the date palms. Sometimes it is called the dromedary; and we cannot here do better than quote from Mr. Palgrave's travels in Central and Eastern Arabia what he says on the confusion that often exists as to the difference between a camel and a dromedary:—

"Barakat and I were mounted on two excellent dromedaries of Aboo-'Eysa's stud; the Nā'ib was on a lovely grey she-camel, with a handsome saddle, crimson and gold. The Meccans shared between them a long-backed black beast; the rest were also mounted on camels or dromedaries, since the road before us was impracticable for horses, at any rate at this time of year. It may be well to make my readers aware, once for all, of the fact that the popular home idea of a dromedary having two humps and a camel one, or *vice versa* (for I have forgotten which of the animals is supplied with a duplicate boss in coloured picture-books), is a simple mistake. The camel and the dromedary in Arabia are the same identical genus and creature, excepting that the dromedary is a high-bred camel, and the camel a low-bred dromedary; exactly the same distinction which exists between a race-horse and a hack; both are horses, but the one of blood, the other not. The dromedary is the race-horse of his species, thin, elegant (or comparatively so), fine-haired, light of step, easy of pace, and much more enduring of thirst than the woolly, thick-built, heavy-footed, ungainly, and jolting camel. But both and each of them have only one hump, placed immediately behind their shoulders, where it serves as a fixing-point for the saddle or burden. For the two-humped beast it exists, indeed, but it is neither an Arab dromedary nor camel; it belongs to the Persian breed, called by the Arabs 'Bakhtee,' or Bactrian. Perhaps there may be a specimen of it at the Zoological Gardens, and thither who chooses may go and have a look at it, only let him not profane the name of 'dromedary' by applying it to the clumsy, coarse-haired, upland Persian beast before him. To see real live dromedaries my readers must, I fear, come to Arabia, for these animals are not often to be met with elsewhere, not even in Syria; and whoever wishes to contemplate the species in all its beauty must prolong his journey to Omān, the most distant corner of the peninsula, and which is for dromedaries what Nejed is for horses, Cachemire for sheep, and Thibet, I believe, for bull-dogs."

When travelling in Nubia, Burckhardt saw the camel almost in a wild state, whole herds being left to pasture unattended by men. They were kept for the sake of their flesh and milk, few being employed as beasts of burden. They even appeared frightened at the approach of men and loaded camels, a circumstance this traveller had never before witnessed. The colour of the camel, as of most domestic animals, is subject to variety. The reddish, or light grey, appears to be preferred to the brown colour. Occasionally, black camels are seen. The Nubian camels are generally white. In Egypt the average price of one of these beasts of burden is from thirty to fifty dollars; but the swift Omān dromedary, which is much valued, sells at a higher rate, and an instance is mentioned in which three hundred dollars were given for one.

The camel is not merely valuable as a beast of burden. Its milk is used for ordinary purposes by the Arabs, that of goats and sheep being generally made into butter. The Arab feeds his colt with it, and even gives it to his mare. Flour made into a paste with sour camel's milk is a common dish among the Bedouins; and rice or flour is often boiled with sweet camel's milk.

Though the flesh of the camel is not only eaten, but relished, by the Arabs, it is not often that a camel is killed for the enjoyment of this luxury. The grease of the camel is kept in goat-skins, and used like butter. The woolly hair of the camel, which, toward the close of spring, is loose, and easily pulled away from the skin, is woven into coarse cloth, used as coverings. Even the dung of the camel is not neglected; it forms the chief material for fuel in Egypt, Arabia, and Persia.



CAMELS IN THE DESERT.

We cannot refrain from one more quotation from Mr. Palgrave, this time in reference to the disposition of the camel:—

"On the 27th of the month we passed with some difficulty a series of abrupt sand-hills that close in the direct course of Wadi Sirhan. Here for the first time we saw the Ghada, a shrub almost characteristic, from its very frequency, of the Arabian peninsula, and often alluded to by its poets. It is of the genus *Euphorbia*, with a woody stem, often five or six feet in height, and innumerable round green twigs, very slender and flexible, forming a large feathery tuft, not ungraceful to the eye; while it affords some kind of shelter to the traveller and food to his camels. These last are passionately fond of ghada, and will continually turn right out of their way, in spite of blows and kicks, to crop a mouthful of it, and then swing back their long necks into the former direction, ready to repeat the same manœuvre at the next bush, as though they had never received a beating for their past voracity. I have, while in England, heard and read more than once of the 'docile camel.' If 'docile' means stupid, well and good; in such a case the camel is the very model of docility. But if the epithet is intended to designate an animal that takes an interest in its rider, so far as a beast can, that in some way understands his intentions or shares them in a subordinate fashion, that obeys from a sort of submissive or half fellow-feeling with his master, like the horse and elephant, then I say that the camel is by no means docile, very much the contrary; he takes no heed of his rider, pays no attention whether he be on his back or not, walks straight on when once set a-going, merely because he is too stupid to turn aside; and then, should some tempting thorn or green branch allure him out of the path, continues to walk on in this new direction simply because he is too dull to turn back into the right road. His only care is to crop as much pasture as he conveniently can while pacing mechanically onwards; and for effecting this his long flexible neck sets him at great advantage, and a hard blow or a downright kick alone has any influence on him, whether to direct or impel. He will never attempt to throw you off his back, such a trick being far beyond his limited comprehension; but if you fall off, he will never dream of stopping for you, and walks on just the same, grazing while he goes, without knowing or caring an atom what has become of you. If turned loose, it is a thousand to one that he will never find his way back to his accustomed home or pasture, and the first comer who picks him up will have no particular shyness to get over. Jack or Tom are all the same to him, and the loss of his old master, and of his own kith and kin, gives him no regret, and occasions no endeavour to find them again. One only symptom will he give that he is aware of his rider, and that is when the latter is about to mount him, for on such an occasion, instead of addressing him in the style of Balaam's more intelligent beast, 'Am not I thy camel upon which thou hast ridden ever since I was thine, unto this day?' he will bend back his long snaky neck towards his master, open his enormous jaws to bite if he dared, and roar out a tremendous sort of groan, as if to complain of some entirely new and unparalleled injustice about to be done him. In a word, he is from first to last an undomesticated and savage animal, rendered serviceable by stupidity alone, without much skill on his master's part, or any co-operation on his own, save that of an extreme passiveness. Neither attachment nor even habit impress him; never tame, though not wide-awake enough to be exactly wild. One passion alone he possesses, namely, revenge, of which he furnishes many an hideous example, while in carrying it out he shows an unexpected degree of far-thoughted malice, united meanwhile with all the cold stupidity of his usual character. One instance of this I well remember; it occurred hard by a small town in the plain of Ba'albec, where I was at the time residing. A lad of about fourteen had conducted a large camel, laden with wood, from that very village to another at half an hour's distance or so. As the animal loitered or turned out of the way, its conducter struck it repeatedly, and harder than it seems to have thought he had a right to do. But not finding the occasion favourable for taking immediate quits, it 'bode its time;' nor was that time long in coming. A few days later the same lad had to re-conduct the beast, but unladen, to his own village. When they were about half way on the road, and at some distance from any habitation, the camel suddenly stopped, looked deliberately round in every direction to assure itself that no one was in sight, and, finding the road far and near clear of passers-by, made a step forward, seized the unlucky boy's head in its monstrous mouth, and lifting him up in the air, flung him down again on the earth with the upper part of his skull completely torn off, and his brains scattered on the ground. Having thus satisfied his revenge, the brute quietly resumed its pace towards the village as though nothing were the matter, till some men, who had observed the whole, though unfortunately at too great a distance to be able to afford timely help, came up and killed it."

The Bactrian Camel (*C. Bactrianus*) is dispersed throughout Mongolia, being found even in high latitudes, and being carried by the Mongolians as far as Lake Baikal. They seem to have spread over Persia and Tartary to China. It is not only considerably larger but is also more heavily built than the dromedary, and possesses two large humps upon the back, the first placed upon the shoulder, the other near the croup.

The colour of its hair is generally of a dark brown, though light varieties occur on some parts of the body; the hair is long and shaggy on the crown of each bunch, the mane, crown of the head, fore-part of the neck; it is very thick and lengthened, and where the fore-leg proceeds from the body there is a large bunch which grows down on the fore-arm.

The Llama is the second genus of this family, and the species thereof are to be found exclusively in the New World.

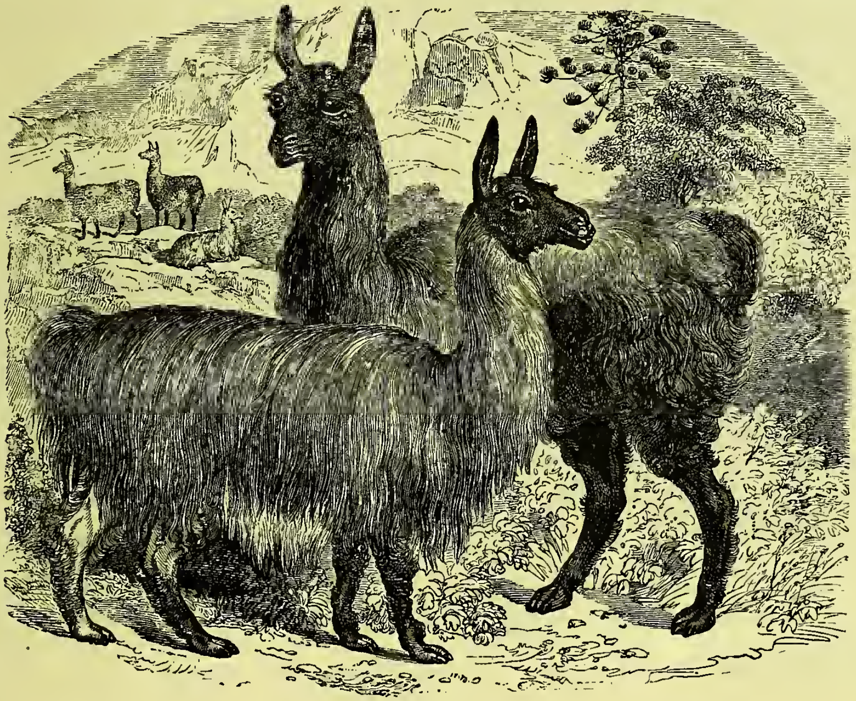
The Vicuna (*Llama vicugna*) is met with in a wild state in the Peruvian Andes; and the Guanaco (*L. huanacos*) also occurs in a wild state over the temperate plains of South America, being met with in Patagonia, at Tierra del Fuego, and as far south as the islands near Cape Horn. Professor R. O. Cunningham, in his "Natural History of the Straits of Magellan," says: "It is, as Mr. Darwin truly remarks, a very elegant animal, being possessed of a long, slender, gracefully-curved neck, and fine legs. It is not easy to describe its general appearance, which combine some of the characters of a camel, a deer, and a goat. The body, deep at the breast but very small at the loins, is covered with long, soft, very fine hair, which, on the upper parts, is of a kind of fawn-colour, and beneath varies from a very pale yellow to the most beautiful snow-white. The head is provided with large ears, in general carried well back, and is covered with short greyish hair, which is darkest on the forehead. Occasionally the face is nearly black. As a rule it lives in flocks of from half a dozen to several hundreds, but solitary individuals are now and then to be met with. They are very difficult to approach sufficiently near to admit of an easy shot, as they are extremely wary, and, on being disturbed, canter off at a pace which soon puts a safe distance between them and the sportsman, even though he should be mounted. Despite their timidity, however, they are possessed of great curiosity, and will sometimes advance within a comparatively short distance of an unknown object, at which they will gaze fixedly till they take alarm, when they effect a speedy retreat. On one or two occasions, when standing motionless or sitting on the ground, I have been within little more than ten yards of a guanaco, which was evidently puzzled by my appearance. Their cry is very peculiar, being something between the belling of a deer and the neigh of a horse. When at a distance, and fired at with the rifle, they in general go through some very singular antics, ducking down their heads, and as it were falling on their knees on the ground, a habit which often at first induced our men to suppose that they were severely wounded, when they were in reality perfectly intact. Mr. Darwin has commented on the singular habit which they possess of depositing their droppings on successive days in the same defined heap, and I have likewise frequently observed this. It would be difficult to over-estimate their numbers on the Patagonian plains; for in whatever direction we walked we always came upon numbers of portions of their skeletons and detached bones. Their two principal enemies are the Patagonian Indians and the puma, as they constitute the principal food of both. The flesh is somewhat dry, and with very little fat, but is very palatable, particularly in the absence of other fresh provisions; and the skin is invaluable to the Patagonians, as furnishing the material of which their long robes are constructed. Occasionally bezoar stones are to

VICUNA ATTACKED BY A PUMA.

be met with in the stomach, which are regarded by the Patagonians as of medicinal value."

The other two species are only known in a domesticated state. The Llama (*L. peruana*) was found employed by the ancient Peruvians at the time of their conquest, and is still used for transporting burdens. They become very docile, and kneel, camel-like, to be loaded. One old and experienced beast generally precedes the drove as leader, his head ornamented with little streamers of cloth and ribbons with bells. They are known to travel fifteen to twenty miles a day through rugged and dangerous passes, and with a weight of a hundred and fifty pounds on their backs.

The Alpaca (*L. pacos*) is also domesticated. It has a very long pendent black fur, which is sometimes varied with white or brown. Both these latter species used to breed freely in the London Zoological Gardens in former years; but since 1860 no offspring has been produced. The Earl of Derby was under the impression that, unlike sheep, these animals never shed their coats, but Dr. Murie found one of the llamas in the Gardens shedding its fleece, and, acting on the hint, had all the herd sheared. From a male llama fourteen pounds of wool was removed; from a male alpaca eight pounds and a half; and from a female alpaca eight pounds. According to Colpaert, the alpacas in Peru are sheared every two or three years, and from the Chinela, a variety of the alpaca, yielding the most esteemed and heaviest kind of fleece, it is rare to have a fleece weighing more than six or seven pounds. The alpacas did not alter in colour on being sheared, but the contour of the body was entirely transformed, for the rough sheep or goat-like hairy covering detracted greatly from the appearance of the animals, the neck was much more proportionately longer than the body, and the thighs of the hind legs were seen to be more than usually free from the body, both these being camel-like peculiarities. Dr. Murie gives photographs of these shorn llama in the "Proceedings of the Zoological Society," 1866.



THE LLAMA.

FAMILY XLIX.—THE MOUSE DEER (*Tragulidæ*).

This family contains, so far as is at present known, the same number of species as the last. These are small deer-like animals, without horns, without cutting teeth in the upper jaw, with canines only in the upper jaw, which are elongate, projecting like little tusks downwards, and backward beyond the lower lip. They are often called Mouse Deer, and by the French Chevrotains. Milne-Edwards has published an exhaustive memoir on this family, with excellent illustrations. The five species of the genus Tragulus are Asiatic, and the single species of the second genus, Hyomoschus, is found in Western Africa. The Javan Chevrotain (*T. javanicus*), so often to be seen in zoological gardens, has several times bred in these countries. It is found in Java, and at Penang. It is easily domesticated, and appears to be common. T. Napu is found in Sumatra; but Dr. Gray thinks it is only the adult form of the previous species. T. Kanchil is one of the smallest of the chevrotains; it is found at Java, Borneo, at Penang, and as far north as Cambodia and Siam. T. Stanleyanus has been sent from Java to the London Zoological Gardens. The common Indian Chevrotain (*T. meminna*) is easily recognised from it being spotted, in addition to having chest markings more or less like the other species. It was originally noted from Ceylon; but Hodgson says it is found in forests throughout all parts of India, as far north as Nepaul.

The genus Hyomoschus differs from Tragulus, and indeed from all other living ruminants in the structure of its feet; the median metacarpal bones are at all ages separate, never uniting to form a common bone, an interesting fact first noted by Messrs. Falconer and Cautley. The metatarsals, though at first distinct, do, in the fully adult state, unite in a single bone.

THE CHEVROTAIN (*T. stanleyanus*).

The Water Chevrotain (*H. aquaticus*) is very rarely to be met with. It has been found at Sierra Leone and Senegal. The peculiarities of its alimentary system were not known to Milne-Edwards. Since the publication of his memoir two specimens have been dissected by Mr. W. H. Flower, who says that the alimentary system presents no obvious character by which it can be distinguished from that of Tragulus.

FAMILY L.—THE DEER (*Cervidæ*).

The Deer range over the whole of the great continents of Europe, Asia, and America, but on that of Africa only one or two species are to be found, and that only along its Mediterranean shores. They have no incisor teeth in the upper jaw (Owen describes six deciduous incisors in the embryo of the fallow deer), which is callous. With one or two exceptions all the males have horns, and with one exception the females want them; they are placed above and behind the orbit, and are generally deciduous. They are called antlers, and are periodical developments of bone, at first covered by a highly vascular skin, which eventually barks off. The tail is short, sometimes very short. It has been noticed that in tropical countries the casting of the antlers is less regular. Some, as Dr. Gray, divide this family into several sub-families, and it is a matter of very great difficulty to divide it into genera. There are upwards of fifty known species.

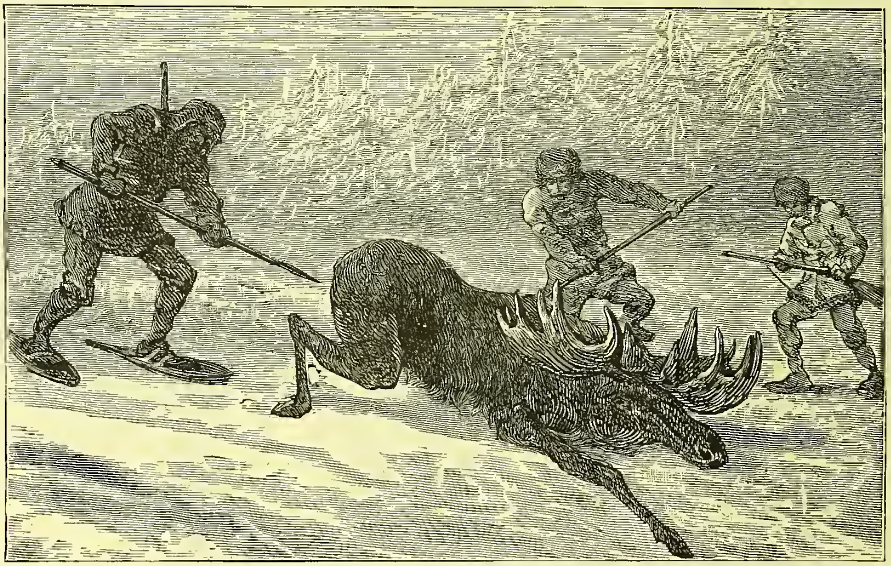
The Reindeer (*Rangifer tarandus*) is now found over the northern regions of Europe, Asia, and America. It is found in Spitzbergen. In Lapland the reindeer feeds on lichens, the buds of conifers, evergreens, and other Arctic plants. During the summer it migrates to the woods and mountains, to avoid the persecution of various insects which are a pest to it, especially the Œstrus tarandi, the very hum of which will put a whole herd of deer to flight.

In summer the coat of the reindeer assumes a deeper hue than in winter; and the young animal has a still darker tinge than the adult. The general colour of the upper part is of a dark brown, all the hairs being more or less deeply tipped with that colour, and of a greyish-white at the base. As the winter approaches the brown assumes a greyish tinge—the whole of the under parts retaining the same shade of greyish-white throughout the year. It forms the chief wealth of the Laplanders, who by means of it supply all their wants of food, clothing, and furniture. A wealthy Lap will possess a herd of at least three hundred deer.

REINDEER (*Rangifer tarandus*).

In America, according to Sir John Richardson, there are two distinct varieties of the reindeer, the one called "the barren ground caribou," the other "the woodland caribou." "The former," he says, "is small of stature, and weighs so little, that I have seen a Canadian voyager throw a full-grown doe on his shoulder, and carry it as an English butcher would a sheep. The bucks are of larger size, and weigh, when in good condition, from ninety to a hundred and thirty pounds. When lean, the flesh is insipid; when fat, and in season, it is superior to that of the finest English venison. . . . . . . The Chippewayans, the Copper Indians, the Dog-ribs, and Hare Indians of the Great Bear Lake, would be totally unable to inhabit their barren grounds, were it not for the immense herds of this deer that exist there. Of the caribou horns they form their fish-spears and hooks; and, previous to the introduction of European iron, ice-chisels and various other utensils were likewise made of them. The hide, dressed with the fur on, is excellent for winter clothing, and supplies the place both of blanket and feather-bed to the inhabitants of these Arctic wilds. The woodland caribou is larger, scarcer, with smaller horns, and vastly inferior as food; its proper country is a strip of low, primitive rocks, well clothed with wood, about a hundred miles wide, and extending at the distance of eighty or a hundred miles from the shores of Hudson's Bay, from Athapescow Lake to Lake Superior, whence the herds travel southwards in the spring, contrary to the usual routine."

The Moose (*Alces machilis*) has very much the same geographical distribution as the reindeer, but it comes further south, and does not wander so far north. In Europe and Asia it comes south as far as East Prussia, the Caucasus, and North China, and in America to British Columbia. The horns are of enormous size, some weighing sixty pounds. It sheds them about the month of February in each year. They are perceptible nine months after birth. For the first year they are cylindrical and stout, the second year they are about a foot in length and not branched, the third year two points are discernible, the fourth year they assume six, the fifth year they are full grown in length, but the blade is still small. From that time forward they yearly increase in breadth and in the number of branches, until there are from fourteen to twenty on each horn.



HUNTING THE MOOSE (*Alces machilis*).

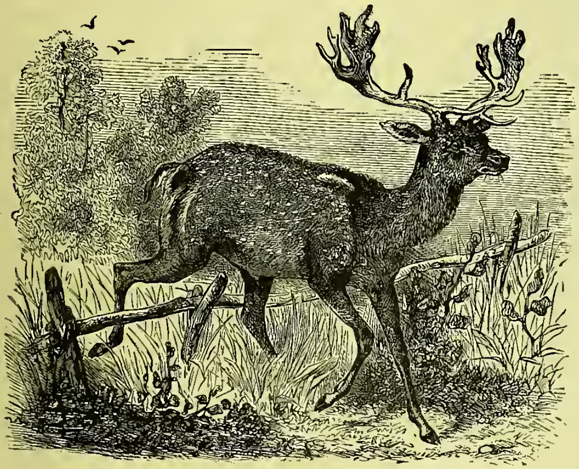
By nature, the elk is timorous, and it usually flies at the sight of man. When excited, its weapons are its horns and hoofs, and so forcibly does it strike with the latter as to destroy a wolf, or other large animal, at a single blow. At such times, the hair on its neck is said to bristle up like the mane of a lion. It is easily domesticated, and its flesh is excellent.

The movements of the elk are rather heavy, from the great height of its shoulders; it does not gallop, like others of the deer kind, but advances at a shuffling kind of amble; while its hoofs, striking against one another, make a strange crackling sound, which is heard at a considerable distance. Its speed, however, is great. During the winter, it lives chiefly on wooded hills; in summer, it frequents the swampy sides of rivers and lakes, often going deep in the water, to escape flies and gnats.

According to Sir John Richardson, this animal has the sense of hearing in very great perfection, and is the most shy and wary of all the deer species; and, on this account, the art of moose-hunting is regarded as the greatest of an Indian's acquirements—particularly by the Crees, who consider themselves able to instruct the hunters of every other tribe.

The genus Cervus, as we would regard it, contains over forty species, and about twenty-six of these may at the present be seen living in the London Zoological Gardens. On those species belonging to the Old World the reader should consult Dr. Sclater's memoir in the

"Transactions of the Zoological Society." We here can enumerate but ten or a dozen of the best-known forms:—The Wapiti (*Cervus canadensis*) is to be met with in North America from east to west. The Red Deer (*C. elaphus*) is found in the forests of Europe and North-west Asia; though rare in England and Ireland, they are pretty numerous in Scotland. A variety is found in Corsica, but we can find no corroboration of Dr. J. E. Gray's statement that it is found in North Africa. The Persian Deer (*C. maral*) is found in Circassia, coasts of the Black Sea, Caucasus, and Persia. The Barbary Deer (*C. barbarus*) is the sole representative of this genus in Africa; it is found along the coast of the Mediterranean, at Tunis, Barbary, and up to the slopes of the Atlas range. The Sambur Deer (*C. aristotelis*) is the deer so well known to the sportsman in Southern India; it is also met with in Ceylon. The Hog (*C. porcinus*) and the Axis Deer (*C. axis*) are also common on the plains of India. A beautiful new species, allied to the last, from the Philippine Islands, has been recently described by Dr. Sclater as C. alfredi. It was presented to the London Zoological Gardens by His Royal Highness Prince Alfred. C. mexicanus is found in North America, and is said, despite its name, not to be found in Mexico, but C. savannarum is met with throughout the whole of Central America.


THE FALLOW DEER (*Dama vulgaris*).

The Fallow Deer (*Dama vulgaris*) is now scarcely to be met with in Europe in a truly wild state, except perhaps in parts of Spain and the Island of Sardinia. It is also found on the coast of Barbary. It has become domesticated in America.

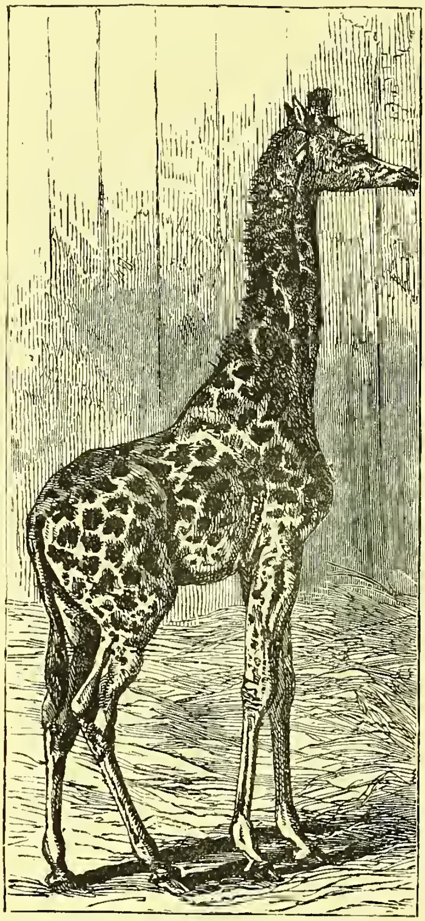
The Roebuck (*Capreolus caprea*) inhabits upland forests throughout Europe. It is not met with in Ireland, and is rarely seen in England. It is very common in parts of France and Spain, also in Italy. The Russian form (*C. pygargus*), described by Swinhoe, is a distinct species from North China.

The Muntjac (*Cervulus muntjac*) is found in the forest districts in India. There are apparently two other species of muntjac (*C. reevesii* and *C. lacrymans*) found over an area extending from Ceylon to China, and in most of the Malay Archipelago. They are small animals, solitary in habits, and fond of hilly ground covered with forest. Their alarm cry is a sharp shrill bark.

We also, following the suggestion of A. Milne-Edwards, place here the Musk Deer (*Moschus moschiferus*), which occurs in the snowy regions of Northern India and Thibet, Nepaul, and Assam. Neither in this nor in the next genus are horns developed. The canines are generally long. In the musk the fur is thick and elastic, fit for a cold country. The males have an odoriferous gland in the middle of their abdomen, which yields an unctuous secretion long known and celebrated as a drug and a perfume; the tail is short.

Hydropotes inermis, a form without the musk-gland, apparently comes in here. It has been found and described by Mr. Swinhoe. He met with it at Port Chin Kiang, on the River Yangtsze, China. They crouch in the reeds and long grass, admitting pretty close approach, and then, rising with a bound, spring away. They were generally put up singly, or in twos and threes. In running they cock their ears, round their fore-legs, bend up their hind-legs, hog their rumps, and scurry away with little quick leaps, very much after the manner of a hare. Heavy shot soon bowled them over. When they ran across cultivated fields the Chinese shouted after them, and set their barking curs to pursue them. They seem to love marshy ground, hence the generic name proposed for them by Mr. Swinhoe. Unlike the deer tribe in general, H. inermis seem to have constantly five to six young ones at a birth; and on an examination of its cranial characters, Sir Victor Brooke would be inclined to leave it in a group by itself, perhaps not far removed from the Rusa group of Asia (*i.e.*, the group containing the Sambur), to which, notwithstanding the absence of horns, many of the cranial characters lead him to think it most nearly allied. The dentition is quite unlike that of Moschus.

Elaphodus cephalophus is described by A. Milne-Edwards, from Moupin, as perhaps intermediate between the genera Cervus and Cervulus. It has horns only about one inch in length.


THE GIRAFFE (*Camelopardalis giraffa*).

FAMILY LI.—THE GIRAFFES (*Camelopardalidæ*).

Unlike the deer, the sole living representative of this family, the Giraffe (*Camelopardalis giraffa*) has no supplementary hoofs on its feet. There are no canine teeth. In both the sexes there are two persistent frontal horns; they are conical, short, and covered with the hairy skin which ends in a tuft of hairs; the neck is very long; the fore feet are longer than the hind feet; the tail is moderate in length, and ends in a tuft of thick hairs. The giraffe is the tallest of all living animals. When standing up the height, from the top of the forehead to the hoof of the fore foot, is from sixteen to eighteen feet. The colour is a light yellow, with large red-brown spots. The tongue is very long, and possessed of great mobility; it is used by the animal to strip from the trees the leaves on which it feeds. It has an awkward gambolling gait; but when in full flight it gallops with the fore legs stiff in rising and falling. It loves to roam in herds over an open country, and is found in Nubia, Abyssinia, and South Africa.

FAMILY LII.—OXEN (*Bovidæ*).

The species of this family form a very natural group—that of the hollow-horned ruminants. The horns consist of a bony core, and a hollow horny case which covers the bone. This horny sheath is, with a single exception, permanent. It is produced by a papillary layer (as matrix) on the core, which itself is covered with periosteum, and a new ring is annually formed. In some antelopes the bony nucleus itself has no internal cavity; in others, as the ox and goat, the nucleus is hollow internally, and the cavities communicate with the frontal sinuses. The first horny case, which is hairy, shreds off in the second year; after this the horns become smoother. To Linnæus, the whole family seemed, from their dentition, alimentary system, and horns, to form a single group, of which he made three genera, Bos (the ox); Capra (the goat); and Ovis (the sheep). Afterwards, Pallas divided the antelopes from the goats. Many attempts have been made to arrange the now very numerous (thirty-five) genera into groups or sub-families. Ogilby in 1842, J. E. Gray in 1846, and Turner in 1852 have each and all done much for the better classification of the group. For the sake of convenience, we had intended to adopt the arrangement given in Dr. Gray's "Catalogue of Ruminant Mammalia," but the publication of Mr. Wallace's most valuable and important work on the "Geographical Distribution of Animals" has made us acquainted with an arrangement of the genera and families proposed by Sir Victor Brooke, which was communicated to Mr. Wallace in manuscript. By his able memoirs on several sub-families in this group, Sir Victor Brooke has proved himself well qualified for such a task; and though in here adopting it we are not, from the short sketch given in the work just cited, able to do it justice, yet our hope is, that by calling attention thereto we shall in no slight measure advance our favourite pursuit and the knowledge of the reader. Sir V. Brooke divides the Bovidæ into the following thirteen sub-families :—

SUB-FAMILY 1.—BOVINÆ.

This equals the old Linnæan genus Bos. It is therefore well marked, and contains the oxen, bison, and buffaloes. Our domestic cattle may be regarded as the descendants of a single species of the typical genus Bos (*B. primigenius*). The white cattle of Chillingham are thought to be the nearest approach to the original form, which has now by cultivation sported into numerous so-called breeds. A few varieties are still distinct enough to be mentioned here, such as the Indian zebu, distinguished by a hump on its back consisting chiefly of fat. This variety is met with in Arabia, Persia, the continent of India, and some parts of Africa. The wild Formosan cow may also be a variety, though Mr. Blyth thinks it a cross between the zebu and the European B. taurus.

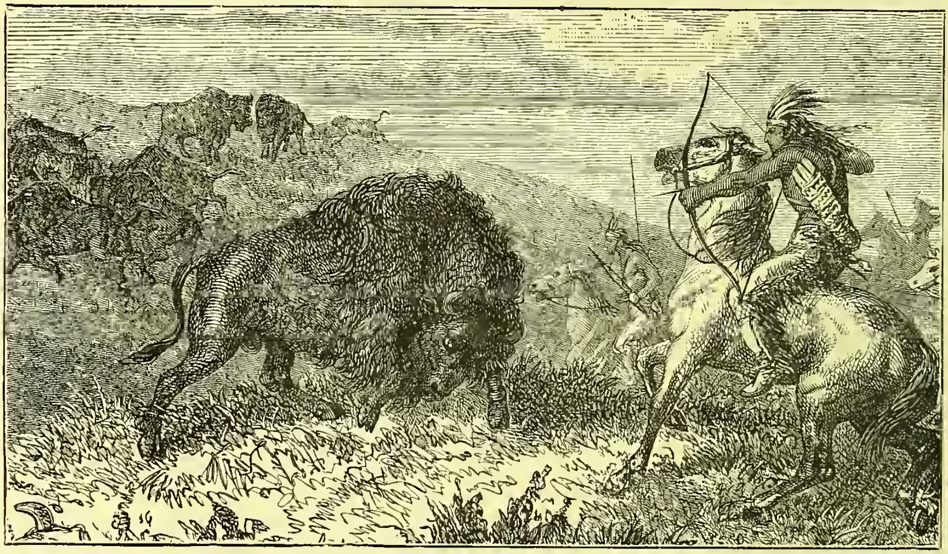
The genus Bison has two species, the first, the Bison (*B. bonassus*), still to be found in Poland and the Caucasus. It has never been domesticated, but herds of these animals have been protected in certain localities in the forest of Bialowesha, in Lithuania, under the direction of the Emperor of Russia. The estimated number of all the herds is 800. They feed on grass and brushwood, and the bark of young trees, especially the willow, poplar, ash, and birch. They do not attain their full stature till their sixth year. They are very shy, and can only be approached from the leeward, as their smell is exceedingly acute. When accidentally fallen in with they become furious, and passionately assail the intruder. When taken young they become accustomed to their keeper, but their anger is excited by the approach of other persons.

The American Bison (*B. americanus*) is found over North America to the slopes of the Rocky Mountains. Sir J. Richardson describes one as being eight feet and a half in length, exclusive of the tail, which is twenty inches, and upwards of six feet in height at the fore-quarters. The head is very large and carried low; the eyes are small, black, and piercing; the horns are short, small, sharp, set far apart, for the forehead is very broad, and directed outwards and backwards, so as to be nearly erect, with a slight curve towards the outward-pointing tips. The hump is not a mere lump of fatty secretion, like that of the zebu, but consists, exclusive of a deposit of fat, which varies much in quantity, of the strong muscles attached to the highly-developed spinous processes of the last cervical and first dorsal vertebræ. The tail is clothed with short fur-like hair, with a long, straight, coarse, blackish-brown tuft at the end. In winter, the whole body is covered with long, shaggy hair, which in summer falls off, leaving the blackish-wrinkled skin exposed, except on the forehead, hump, fore-quarters, under jaw, and throat, where the hair is very long and shaggy, and mixed with much wool. Catesby states that "in summer the general colour of the hair is between dark-umber and liver-brown, and lustrous. The tips of the hair, as it lengthens in winter, are paler, and before it is shed in summer much of it becomes of a pale, dull, yellowish-brown. In the female the head is smaller, and the hair on the fore parts is not so long as it is in the male." These animals, it should be observed, are often called "buffaloes."

Congregating in vast herds, the bisons are said to cover the wide-extended savannahs of the more southern districts of North America for miles in extent. According to Lewis and Clarke, "such was their multitude as they crossed the water, that although the river, including an island over which they passed, was a mile in length, the herd stretched, as thick as they could swim, completely from the one side to the other." On another occasion, they say, "If it be impossible to calculate the moving multitude which darkened the whole plains, still we are convinced that 20,000 would be no exaggerated number."

Few animals minister more largely to the wants, and even the comforts, of man, than the American bison. Catlin says: "There are, by a fair calculation, more than 300,000 Indians who are now subsisting on the flesh of the buffaloes, and by these animals supplied with all the luxuries of life which they desire, as they know of none others. The flesh of a bison in good condition is very juicy and well flavoured, much resembling that of well-fed beef." Others describe it as bearing the same relation to common beef that venison bears to mutton. The tongue, when well cured, is said to surpass that of the common ox as a relish. All travellers concur in praising the hump as rich, savoury, tender, and delicious. This is the fleshy part that covers the long spinous processes of the anterior dorsal vertebræ, and is called "bos" by the Canadian voyagers, and "wig" by the Orkney men in the service of the Hudson's Bay Company. Sir John Richardson, to whom we owe the fact, says also that much of the pemmican used by the voyagers attached to the fur companies is made of bison meat, procured at their posts on the Red River and Saskatchewan, and that one bison cow in good condition furnishes dried meat and fat enough to make a bag of pemmican weighing 90 lbs.

The Indian wild cattle belong to the genus Bibos. The Gayal (*B. frontalis*) is common in the hills which form the eastern boundary of Bengal, and it is also found in Ceylon and in the mountains of Malabar, especially in those north from Paligaut. The rude inhabitants of the hills on the frontiers of Bengal consider the gayal as their most valuable property. Its milk is remarkably rich, and its flesh affords them their most luxurious feast. These people have tame gayals, which occasionally breed; but the greater part of their stock is bred in the woods, and caught, after which, for a wild animal, it is easily domesticated. The usual manner employed to catch the full-grown gayal is to surround a field of corn with a strong fence; one narrow entrance is left, in which is placed a rope with a running noose, which secures the gayal by the neck as he enters to eat the corn. Of ten so caught, perhaps three are hanged by the noose running too tight, and by the violence of their struggling. Young gayals are caught by leaving in the fence holes of a size sufficient to admit a calf, but which excludes the full-grown gayal. The calves enter by these holes, which are then shut by natives who are watching, and who secure the calves. The gayal usually goes in herds of from twenty to forty, and frequents dry valleys, and the sides of hills covered with forests."



HUNTING THE BISON (*Bos americanus*).

The Gaur (*B. gaurus*) and the Sondaic Ox (*B. sondaicus*). The first and last are also found in Java and Borneo.

The Yak (*Poëphagus grunniens*) is found only in the high plains of Western Thibet, and when wild, is said to be savage and dangerous. It is, perhaps, the Poëphagus described by Ælian. Its tail was used from an early period by the Mongols and Tartars, being one of the distinguishing insignia of superior officers. In India these tails are mounted on ivory or silver handles, and, under the name of chowries, are used to brush away the flies. A domestic breed is kept by the natives of Thibet. Though not large-boned, they seem, from the profuse quantity of hair with which they are provided, to be of great bulk. These cattle are pastured in the coldest parts of Thibet, on the short herbage peculiar to the mountains and bleak plains. The mountains which divide Thibet from Bootan, whose summits are mostly covered with snow, is their favourite haunt.

They form a very valuable property to the tribes of itinerant Tartars, who live in tents, and tend them from place to place; at the same time they afford their herdsmen an easy mode of conveyance, a good covering, and wholesome subsistence. Never employed in agriculture, they are extremely useful as beasts of burden, for they are strong, sure-footed, and carry a great weight. Tents and ropes are made of their hair, and caps and jackets of their skins for the humbler herdsmen. The care of their keepers is rewarded for selecting them good pastures in the abundance of rich milk which they give, and in the very excellent butter it yields. It is their custom to preserve this in skins or bladders, and the air being thus excluded, it will keep in that cold climate throughout the year. Thus, after some time tending their herds, when a sufficient store is accumulated, it remains only to load their cattle, and drive them to a proper market with their own produce, which constitutes a most material article of commerce to the utmost verge of Tartary.

THE YAK (*Poëphagus grunniens*).

The Buffalo (*Bubalus buffalus*) is found in South Europe, North Africa, and India. The horns are of very large size. It is often called the arnee.

The Cape Buffalo (*B. caffer*) is a native of South Africa. It is found in troops frequenting watered glens and ravines among the hills, and delights in heavy grass pastures. Their horns are much recurved at their tips, and their bases are close together. B. brachyceros and B. centralis are also African species.

Anoa depressicornis is a very peculiar form found wild in the Celebes.

Sub-Family 2.—Tragelaphinæ.

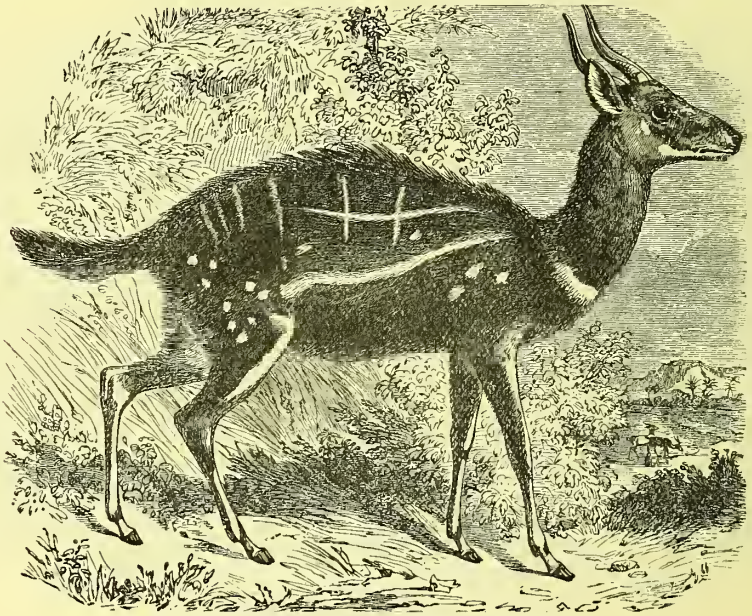
We have in this group the Bovine Antelopes. The males only have horns, and these are sub-spiral, and inclined backwards. The nose is ox-like, forehead flat. With the exception of the Nylghau, all the species are African.

The Eland (*Oreas canna*) is well known in connection with the attempts made to domesticate it in England by one of the Earls of Derby. It inhabits the southern portions of

Africa, and is the largest and heaviest of all the antelopes, and its flesh is most excellent. Another species (*O. derbianus*) is found in West Africa.

The Bosch-bok (*Tragelaphus sylvaticus*) is found in South and Central Africa. Dr. Kirk met with it on the Zambesi, and says that it varies greatly in colour and spotting, and that in muddy regions its hoofs are elongated. There are at least seven other species of this genus. The Harnessed Antelope (*T. scriptus*) is a native of West Africa; T. spekii, found in Central Africa by Speke, and described by Dr. Sclater; T. euryceros (tropical Africa); T. kuda (South and Central Africa up to Abyssinia); and T. tendal (Abyssinia).

The Nylghau (*Portax picta*). This animal is more powerful and muscular, but less graceful in its proportions than the red deer. It is a native of India, where it is said to be very abundant, but is rare in Madras and north of the Ganges. The adult male differs widely from the female in colour: he being greyish-black, and she a yellowish-bay. Though ill-tempered by fits, these animals are generally docile; so much so, indeed, that in India they are occasionally put into harness. They breed very regularly in this country.



THE HARNESSED ANTELOPE (*Tragelaphus scriptus*).

SUB-FAMILY 3.—ORYGINÆ.

This contains but two genera of deer-like Antelopes. The horns are generally slender, long, ringed at base; the neck or throat maned. All the species are African. Perhaps the best known, as oftenest seen in menageries, is the Leucoryx (*Oryx leucoryx*). It is a native of the north, east, and west of Africa, and is the species doubtless figured on some of the Egyptian monuments. O. beisa, with straight horns, is found in Abyssinia; the Gemsbock (*O. gazella*), with horns straight, but shelving backwards, is common in South Africa; and O. beatrix is a native of the shores of the Red Sea. The Addax (*Addax nasomaculatus*) is not uncommon in North Africa, and can be generally seen in the London Zoological Gardens.

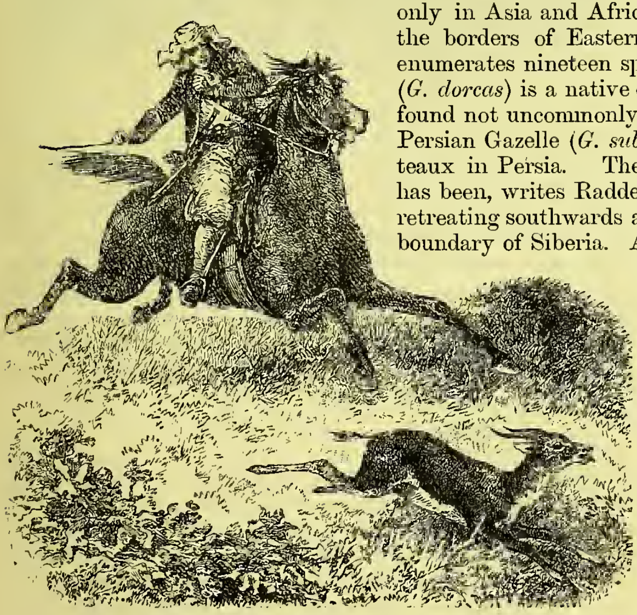
SUB-FAMILY 4.—HIPPOTRAGINÆ.

The Equine Antelopes form a section of antelopes, of the size of a small horse, and provided with a mane, they are to be found in tropical Africa, and extend to the Cape. The Sable Antelope (*Hippotragus niger*), occurs in the Zambesi district, and there is a spocimen in the London Zoological Gardens. H. equina is now almost extinct. At one time it abounded on the northern confines of the Cape colony. It is figured by Dr. A. Smith in his "Illustrations of South African Zoology," Plate xxviii. A beautiful new species has been described by Dr. Heuglin from Upper Nubia, where it was discovered by Sir S. Baker, after whom it is called H. bakeri. It is about the size of a horse, is only to be met with in open places, and is very swift and shy. It lives in herds of about thirty individuals. Both the males and females have horns. When arriving at the banks of a river, Sir S. Baker writes, the herd never descend to the water until one or two have gone forward as an advanced guard. These narrowly scrutinise all sides, while the expectant herd awaits their decision; and although painfully thirsty during the hot season, they never drink until the leaders have assured them of safety. The margins of rivers here are generally covered with thick bush, the resort of lions and leopards, which lie in ambush for the animals which visit the watering-place, hence the extreme caution of this wary antelope. The adult horns are about twenty-seven inches in length along the upper surface, from the base to the tip.

THE ADDAX (*Addax nasomaculatus*)

Sub-Family 5.—Gazellinæ.

The Gazelles form a pretty well-defined sub-family, the species of which are met with only in Asia and Africa, the Saiga just overstepping the borders of Eastern Europe. Sir Victor Brooke enumerates nineteen species of Gazella. The Gazelle (*G. dorcas*) is a native of Syria, Egypt, Algeria, being found not uncommonly about the Oran Sahara. The Persian Gazelle (*G. subgutturosa*) occurs on high plateaux in Persia. The Siberia Gazelle (*G. gutturosa*) has been, writes Radde, ever since the days of Pallas retreating southwards and eastwards from the Russian boundary of Siberia. As winter approaches, enormous herds collect together, and wander northwards, crossing the Argun near to the east of Soktui and Abigaitui. The river and small lakes being so hard frozen that they can no longer break the ice with their feet, they are impelled to wander northward in search of snow. The Spring-bok (*G. euchoris*) is found in South Africa, this being the most southern limits of the genus. The G. arabia occurs in South Arabia, G. cuvieri in Algeria.


GAZELLE HUNTING IN ALGIERS.

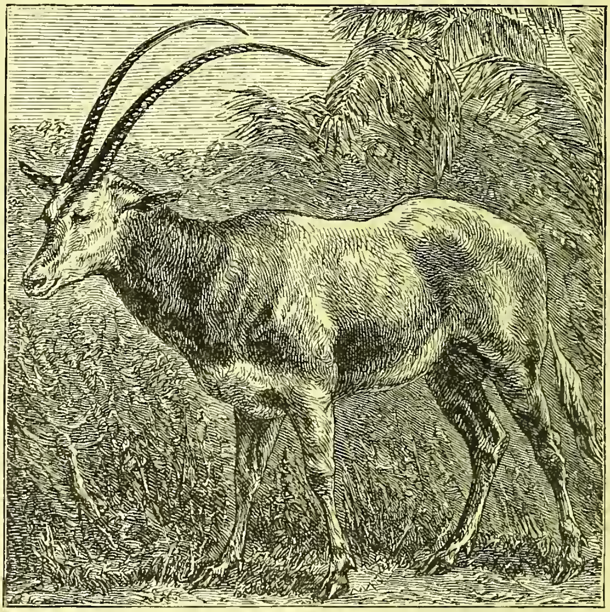
The Yellow Sheep of Mongolia (*Procapra gutturosa*) has a long, soft, pale yellow fur, with straight cylindrical horns. In Pekin it is called Hwang Yang. It is brought from Mongolia in large numbers in a frozen state, and sold for food, the flesh being in great esteem for its fine flavour and tenderness. It is very difficult of approach, and it is a great feat for the hunter to shoot one. The Goa (*P. picticauda*) is found in Thibet.

The Antelope (*Antilope bezoartica*) is a native of the plains of India.

The Pallah (*Æpyceros melampus*) is found frequenting open parts of the forests of South Africa, occurring in herds.

The Saiga Antelope (*Saiga tartarica*) is a strange-looking sheep-like antelope, with the nostrils placed on the end of an immense, broad, truncated, heavy nose. The horns are small, tail short. It inhabits Siberia, the steppes of Eastern Europe, and Western Asia from Poland to the Irtish River.

The Chira (*Pantholops hodgsonii*) occurs in the open plains of Western Thibet.



THE LEUCORYX (*Oryx leucoryx*) (p. 160).

Sub-Family 6.—Antilocaprinæ.

This sub-family is formed for the Prong-horned Antelope (*Antilocapra americana*). It inhabits both sides of the Rocky Mountains, extending northwards to the Columbia River, west to California, and east to the Missouri. Both the male and female possess horns, which are hollow-forked, and, as Bartlett and Caufield have proved, annually deciduous. Dr. Murie, in an excellent paper on the anatomy of this antelope, points out that the structure of the hair would remove it from the antelopes and place it among the sheep; and he considers the structural resemblance of the horns to be nearer those of the Bovidæ than of the Cervidæ, notwithstanding their deciduous nature. Indeed, as Buffon has asserted of the ox, and Ogilby of the oryx and leucoryx, these ruminants offer an example of the refoliation of horn; also adds Murie, "Curiosity, a trait of character manifested in the goats above all the other ruminants, is a predominant feature in the prong buck; for Richardson tells us how the Indians dress themselves in a white shirt, flutter a white rag, or lie down and kick up their heels, and by such means cause these animals to approach near enough to be shot. The rapidity of the prong buck is said to be something marvellous. Anderson says: "So rapidly do their legs propel their bodies over the ground, that, like the spokes of a fast-turning wheel, we can hardly see them, but instead observe a gauzy or film-like appearance where they should be visible."

Sub-Family 7.—Cervicaprinæ.

We have here a group of antelopes peculiar to Africa. The Sing-Sing (*Cervicapra sing-sing*) is a native of West Africa, and is said to be half-domesticated at the Gambia. The Water Buck (*Kobus ellipsiprymnus*) occurs in South and East Africa. The Reh Bok (*Peloea capreola*) is a native of South Africa. All the species of Nanotragus, with one exception, are from the east or south of Africa. The Stein Bok of the Cape Colonists is N. campestris. N. pygmæus is found on the West Coast, and is the smallest of all known ruminants. The synonyms of this interesting Antelope, known to science for now upwards of 150 years, have been most carefully worked out by Sir Victor Brooke. Neotragus saltiana is found in Kordofan, Abyssinia.

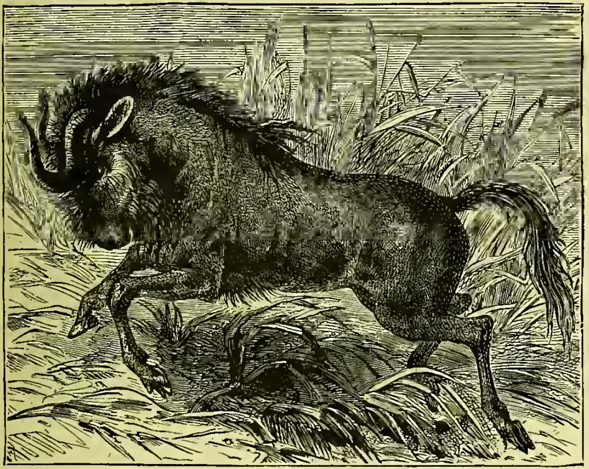
Sub-Family 8.—Cephalophinæ.

This contains the Bush Boks of Africa, belonging to the genus Cephalophus, and the four-horned antelopes of India, belonging to Tetraceros. C. maxwellii, from Senegal and the Gambia, is not uncommon in collections, and has bred several times in the London Zoological Gardens. The Bay Antelope (*C. dorsalis*) occurs on the Gold Coast. G. longiceps has been described by Professor Bocage, from Angola. There are now more than twenty-three species of this genus known.

The Four-horned Antelope (*T. quadricornis*) is met with throughout the hill districts of India.

Sub-Family 9.—Alcephalinæ.

Without exception, these large stag-like antelopes are only found in Africa, the genus being only met with south of the Equator. They are large animals, with horns having recurved tips, and placed far back. The body is stout, legs slender, tail long, like that of a horse. The Gnu (*Catoblepas gnu*) has the chest maned. The Brindled Gnu (*C. gorgon*) has no mane on the chest. There are eight, perhaps more, species of Alcelaphus. The Harte beest (*A. caama*) is found in flat, wooded districts throughout South Africa. The Bubaline Antelope (*A. bubalis*) occurs in North Africa, and is met with at a little distance from Tunis, where also A. major is to be met with. The former is much smaller than the Harte beest, without any markings on the feet; the latter is as large as the Harte beest, and has black markings on all the feet above the hoofs. The Bless Bok of South Africa is A. albifrons.



THE BRINDLED GNU (*Catoblepas gorgon*).

Sub-Family 10.—Budorcinæ.

It contains only one genus, Budorcas. The Yākin (*B. taxicolor*) is a large antelope, with an ox-like head and neck and a goat-like tail. The limbs taper, and are clad with hair like a sheep. It is found on the Himalaya, in all the high ranges north-east of Debrooghur, and is far from uncommon. It lives up among the snow, and is seldom seen below it. The full-grown males are very fierce. Sometimes these antelopes occur in pairs, and at other times in herds of about twenty. They are swift of foot, and good climbers. The above facts about this interesting species, which for the present seems to fall into none of the quoted sub-families, are from a note by Dr. Anderson, of the Indian Museum, Calcutta.

Sub-Family 11.—Rupicaprinæ.

This sub-family is established for the Chamois (*Rupicapra tragus*), including the Izard of the Pyrenees as merely a sub-species; then this species is found inhabiting the high European mountains, from the Pyrenees to the Caucasus. It dwells in small herds, cropping the herbage of the mountain-sides. This animal is about the size of a large goat; its colour is of a dark chestnut-brown, with the exception of the forehead, the sides of the lower jaw, and the muzzle, which are white. Its horns, rising just above the eyes, are black, smooth, and straight, for two-thirds of their length, when they suddenly curve backwards. Its hoofs are admirably adapted to avail themselves of any little roughness or projection, either of the naked granite or the icy glacier; and its hair is thick, long, and coarse.

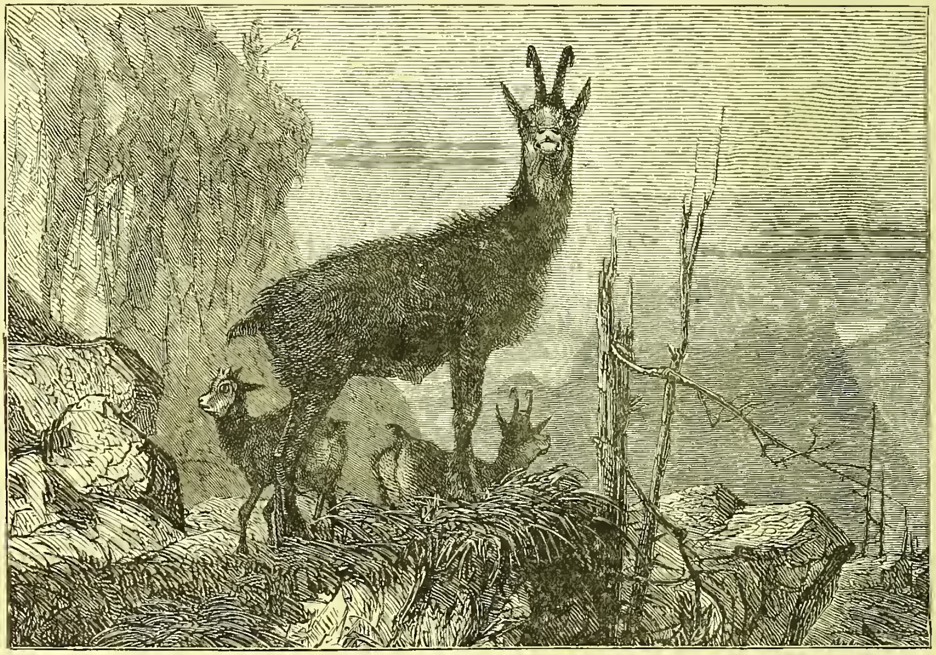
Provided with a gun, a bag of provisions, and iron-shod staff to assist in climbing and leaping, an axe to cut steps in the towering parapets of ice, and shoes studded with iron points, the chamois-hunter traverses the mountains, and prowls warily for his prey, not only during the day, but the night. Wherever the chamois flies he follows, whether it be along narrow ledges of rock, by the brink of yawning abysses, or up the ragged sides of precipices, where a short leap or a wrong step would prove instantly fatal.

SUB-FAMILY 12.—NEMORHEDINÆ.

These goat-like antelopes lead us naturally to the next and last sub-family. The species of the first genus (Nemorhedus) are to be met with in mountain ranges of Nepaul to northern China, Japan, as far south as Formosa, and in the Malay Peninsula. The solitary species of the second genus (Aploceros) occurs in the Rocky Mountains of North America. N. swinhœi occurs on the Snowy Mountains of Formosa. N. crispa is a native of Japan. N. bubalina and N. goral are found in Nepaul. N. caudatus in North China. While the Mountain Goat of America (*A. americanus*) is confined to the northern parts of California.

SUB-FAMILY 13.—CAPRINÆ.

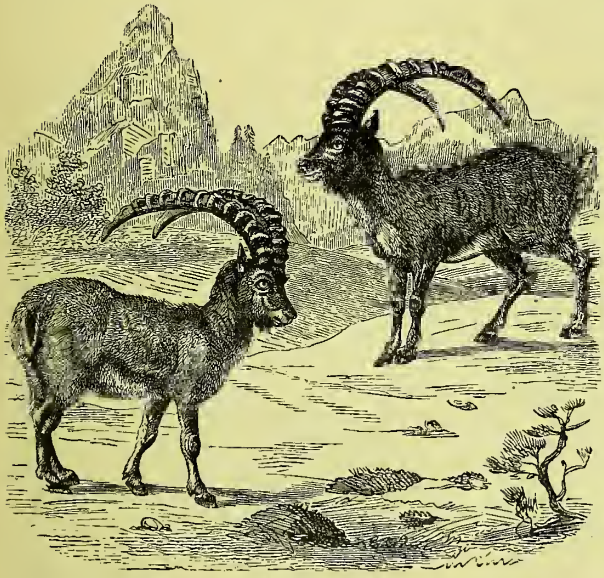
The sheep and goats form a numerous section of the hollow-horned ruminants, few of them being found in Africa. They occur over the temperate regions of Europe, Asia, America, and extending as far south as Abyssinia. Dr. Gray divides the bearded species (goats) from the unbearded (the sheep), making five genera of the former, and four of the latter—not including Ovibos. For our present purposes it will suffice to divide the sub-family into the genera: Capra (for the goats and ibexes); Ovis (for the sheep); and Ovibos (for the musk sheep). And space will only allow a few of the species (twenty-four) to be alluded to. The Pyrenee Ibex (*Capra pyrenica*) is to be found on the Spanish side of the Pyrenees, but in small and decreasing numbers. The Ibex (*C. ibex*) is found, but nowadays very rarely, on the Savoy Alps. It has been nearly extirpated from the Carpatheans by poachers. A closely-allied species, the Tek, is found in Siberia. The Jharal (*C. jemlaicus*) is met with in Nepaul. C. nubiana is the North African species.



THE CHAMOIS (*Rupricapra tragus*).

The Goat (*C. ægagrus* or *hircus*) is only known in a domesticated or in a semi-wild state. "The opinions of naturalists," says Mr. Bell, "have been much divided respecting the original stock of our domestic goat, some referring it to the *Ægagrus*, and others to the *Ibex*. Buffon appears to have adopted the latter opinion; but most modern zoologists who have paid much attention to the question, and who have brought to the consideration of it all the helps which recent discoveries in philosophical zoology have furnished, have leaned to the belief that the *Ægagrus*, or wild goat of the mountains of Caucasus, and of Persia, is the true original stock."

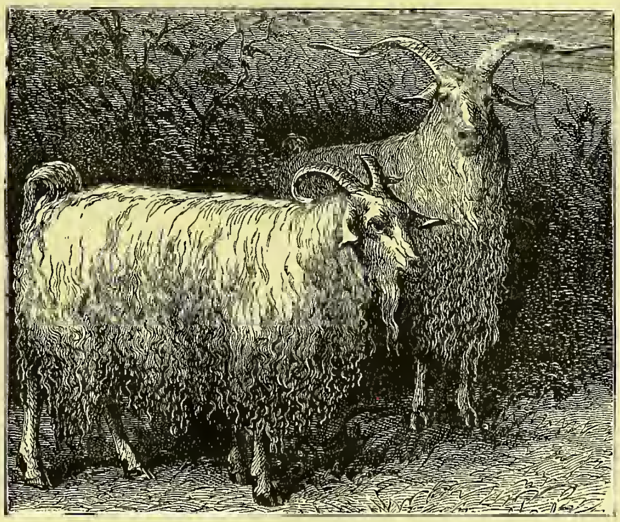
According to Buffon, the goat is superior to the sheep, both in sentiment and dexterity: he is stronger, lighter, and more agile than the ram; he is sprightly, capricious, and given to wander; and it is with difficulty he can be confined to a flock. He loves to retire into solitude, to climb steep and rugged places. Though he seems to feel the effects of severe cold, he is not afraid of rain or storms, or too great a degree of heat; he cheerfully exposes himself to the sun, and, without inconvenience, sleeps under its most ardent rays. But he is inconstant in his passions, and irregular in his actions.


THE IBEX (*Capra ibex*).

The skin of a goat, particularly of a kid, which takes a dye better than most other skins, is of great value to the glove-maker. The medical properties of goat's milk and whey have been highly extolled, and goat's cheese is much valued.

The Angora Goat inhabits the tract of land which surrounds Angora and Beibazar, in Asiatic Turkey, where the goatherds bestow much care on their flocks, frequently combing and washing them.

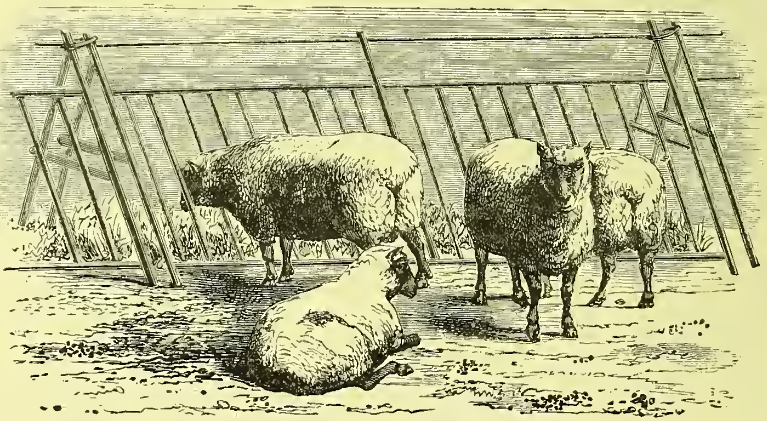
Of the other important varieties may be mentioned the Shairl Goat of the English. This is domesticated in Thibet, and the wool is exported to Cashmere, where it is manufactured into various cloths and felts, of which the finest are known in Europe by the name of "shairl."


THE ANGORA GOAT (*Capra ægagrus.* Var.).

The Common Sheep (*Ovis aries*) is only known in a domestic state. The most ancient records of our race, both sacred and profane, tell us of the sheep as already an animal domesticated for the food and clothing of man; but it is a significant fact, that the Scythians of the elevated plains of Inner Asia dwell in that part of the earth where the wild, sheep-like argali still exists in the greatest numbers.

The ancient Hebrews were wholly an agricultural and pastoral people. Hence, among many references to such a life, their pastures are described as "clothed with flocks." The course of the diffusion of domesticated races from the Asiatic centre, where history points to the beginning of pastoral life, may easily be traced. The period at which the sheep was introduced to our island cannot be determined. It appears to have existed in England prior to its conquest by the Romans, though it is not mentioned by them in their accounts of the productions of this *ultima Thule.* But as the Britons of Kent had long traded with the Gauls, who, we know, possessed sheep, and used at an early period a sort of felted cloth, it is reasonable to conclude that flocks tenanted the hills of our country long before the arrival of Julius Cæsar. The proof is positive, however, of the antiquity of sheep in the British Islands, though we can scarcely determine whether they were domesticated or not. Boëthius describes a wild breed in the Island of St. Kilda, exceeding the largest goat in size, with heavy, massive horns, longer than those of an ox, and as bulky, and with a tail hanging to the ground. Pennant remarks, that such an animal as Boëthius describes is figured on a bas-relief taken out of the wall of Antonius, near Glasgow. Wool has been regarded, from the earliest times of English history, as our great national raw material for woven goods.

The Shapoo (*O. vignii*) is found at an elevation of from 12,000 to 14,000 feet at Ladakh in Thibet. The Punjab Wild Sheep is O. cycloceros. The Mouflon (*O. musimon*) lives in large herds, sometimes of a hundred individuals, and is found in the most elevated parts of Sardinia and Corsica, and in the province of Murcia in Spain. The Argali (*O. argali*) occurs in Siberia, Kamtchatka, and the Rocky Mountains. O. nahoor is a native of Nepaul; and O. tragelaphus is the species met with in Northern Africa.

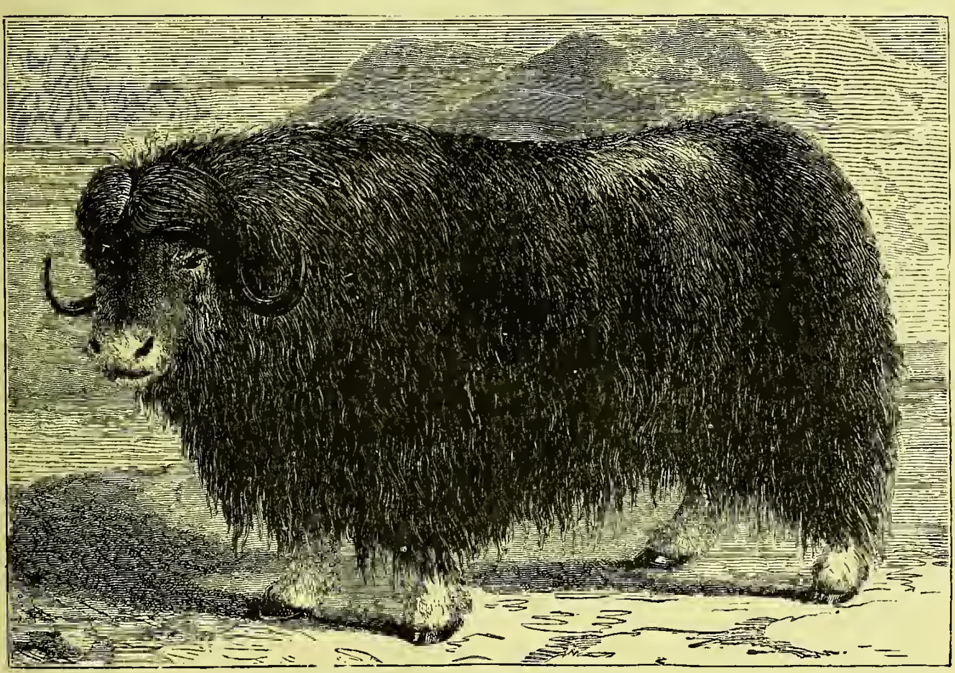


THE COMMON SHEEP (*Ovis aries*).

The Musk Sheep (*Ovibos moschatus*) inhabits Arctic America, chiefly the barren snowy lands, in lat. 6° N. This interesting species is often included under the name Musk Ox among the members of the first sub-family. Sir Leopold McClintock had many opportunities of becoming acquainted with this animal. We have abstracted the following from his diary of the voyage in search for Sir John Franklin:—

"1853, 22nd May.—At eleven o'clock we saw and shot two very large musk bulls; we found them in better condition than any we have ever seen. I shall never forget the death-struggle of one of these noble bulls. A Spanish bull-fight gives no idea of it. This animal was shot through the lungs. As he stood fiercely watching us, prepared, yet unable to charge, his small, but fixed, glaring eyes were almost concealed by masses of shaggy hair, and his whole frame was fearfully convulsed with agony. The tremulous motion was communicated to his enormous covering of tangled wool and hair; even the coarse thick mane seemed to rise indignant, and slowly waved from side to side. It seemed as if the very fury of his passion was pent up within for one final—a revengeful charge. There was no roaring; the majestic beast was dumb; but the wild gleam of savage fire which shot from his eyes, and his menacing attitude, was far more terrible than the most hideous bellow. We watched in silence, for time was doing our work, nor did we venture to lower our guns until, his strength becoming exhausted, he reeled and fell. I have never witnessed such an intensity of rage, nor imagined for one moment that such an apparently stupid brute, under any circumstances of pain and passion, could have presented such a truly appalling spectacle. It is almost impossible to conceive a more terrific sight than that which was presented to us in the dying moment of this matchless monarch of these northern wilds. A mile or two farther on we saw four milch cows, and a very small calf."

"6th June.—I walked for three or four miles, over to the hills, round the last bay; saw tracks of the fox, and a few deer; also burrows of lemmings; saw an ox in the distance, which allowed me to approach within fifty yards of him; he stood quietly, rubbing the tips of his massive horns against his fore legs. While I was examining my gun I heard his gallop, and saw him coming on; fired both barrels just in time to stop him when ten or fifteen yards off; having reloaded I fired again, and despatched him. It is wonderful how so large an animal could support life in such an extremely barren country."



THE MUSK SHEEP (*Ovibos moschatus*).

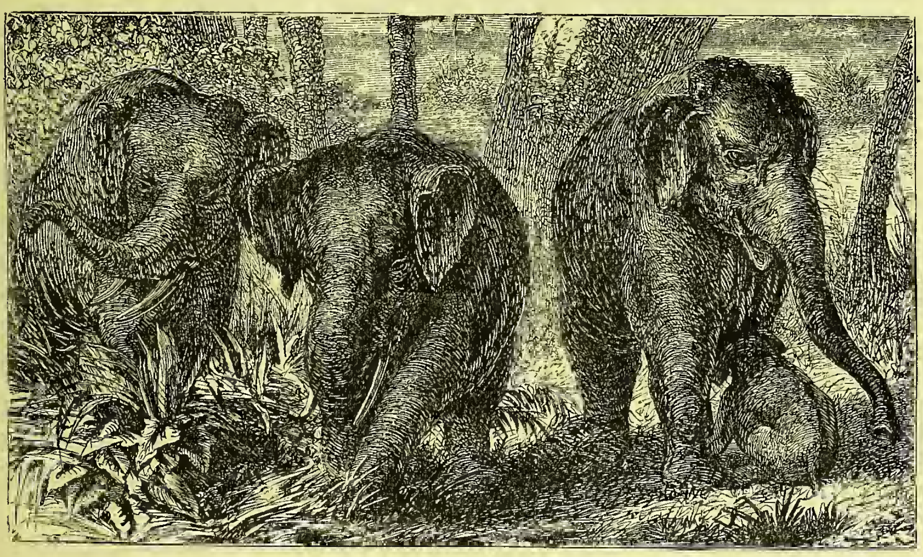
ORDER VIII.—THE ELEPHANTS (*Proboscidea*).

To this order there now belongs but a single genus, containing only two species, the feeble remnants, writes Mr. Wallace, of a host of gigantic creatures which roamed over all the great continents, except Australia, during the Tertiary period, and several of which were contemporary with man. At least fourteen extinct species of Elephas, and a rather greater number of the allied genus Mastodon, have now been discovered. In this order the incisor teeth in the upper jaw are two, large and exserted; there are no canine teeth; the molars are very large; the feet are pentadactylous; the nose is elongated into a prehensile proboscis; the large teeth which supply ivory are the incisors of the upper jaw. Linnæus thought there was but one species; but Blumenbach distinguished the African from the Asiatic by the structure of the molar teeth.

In the Indian Elephant (*Elephas indicus*) not only are the lamina of the molar teeth flat, with a linear crown, but the ears are moderate, while in the African Elephant (*E. africanus*) the lamina of the teeth have lozenge-shaped crowns, the ears are very large, and the forehead is more retiring. Sir J. Emerson Tennent, in his account of Ceylon, thus describes the Indian elephant:—

"Although found generally in warm, sunny climates, it is a mistake to suppose that the elephant is partial either to heat or to light. In Ceylon, the mountain-tops, and not the sultry valleys, are his favourite resort. In Oovah, where the elevated plains are often crisp with the morning frost, and on Pedro-talla-galla, at the height of upwards of eight thousand feet, they are found in herds, whilst the hunter may search for them without success in the jungles of the low country. No altitude, in fact, seems too lofty or too chill for the elephant, provided it affords the luxury of water in abundance; and, contrary to the general opinion that the elephant delights in sunshine, he seems at all times impatient of its glare, and spends the day in the thickest depth of the forest, devoting the night to excursions, and to the luxury of the bath, in which he also indulges occasionally by day. This partiality for shade is doubtless ascribable to his love of coolness and solitude; but it is not altogether unconnected with the position of his eye, and the circumscribed use which his peculiar mode of life permits him to make of his faculty of sight. All the elephant-hunters and natives to whom I have spoken on the subject concur in the opinion that his range of vision is circumscribed, and that he relies more on his ear and his sense of smell than on his sight, which is liable to be obstructed by the dense foliage; besides which, from the formation of his neck, he is incapable of directing the range of his eye much above the level of his head. The elephant's small range of vision is sufficient to account for his excessive caution, his alarm at unusual noises, and the timidity and panic exhibited by him at trivial objects and incidents which, imperfectly discerned, excite his suspicions for his safety. In 1841 an officer was chased by an elephant which he had slightly wounded; and which, seizing him in the dry bed of a river, had its fore-foot already raised to crush him; but the animal's forehead being caught at the instant by the tendrils of a climbing plant which had suspended itself from the branches above, it suddenly turned and fled, leaving him badly hurt, but with no limbs broken. I have heard many similar instances, equally well attested, of this peculiarity in the elephant. On the other hand, their power of smell is so remarkable as almost to compensate for the deficiency of sight. The herd are not only apprised of the approach of danger by this means, but when scattered in the forest, and dispersed out of the range of sight, they are enabled by it to re-assemble with rapidity, and adopt precautions for their common safety. The same necessity involves a delicate sense of hearing, and the use of a variety of noises or calls, by means of which elephants succeed in communicating with each other upon all emergencies. 'The sounds which they utter have been described by the African hunters as of three kinds: the first, which is very shrill, produced by blowing through the trunk, is indicative of pleasure; the second, produced by the mouth, is expressive of want; and the third, proceeding from the throat, is a terrific roar of anger or revenge.' These words convey but an imperfect idea of the variety of noises made by the elephant in Ceylon; and the shrill cry produced by blowing through his trunk, so far from being regarded as an indication of 'pleasure,' is the well-known cry of rage with which he rushes to encounter an assailant. Aristotle describes it as resembling the hoarse sound of a 'trumpet.' The

French still designate the proboscis of an elephant by the same expression, '*trompe*,' which we have unmeaningly corrupted into trunk, and hence the scream of the elephant is known as 'trumpeting' by the hunters in Ceylon. Their cry when in pain, or when subjected to compulsion, is a grunt, or a deep groan from the throat, with the proboscis curled upwards and the lips wide apart. Should the attention of an individual in the herd be attracted by any unusual appearance in the forest, the intelligence is rapidly communicated by a low suppressed sound made by the lips, somewhat resembling the twittering of a bird, and described by the hunters by the word 'prut.' But a very remarkable noise has been described to me by more than one individual, who has come unexpectedly upon a herd of elephants during the night, when their alarm was apparently too great to be satisfied with the stealthy note of warning just described. On these occasions the sound produced the hollow booming of an empty tun when struck with a wooden mallet or a muffled sledge. Major Macready, Military Secretary in Ceylon in 1836, who heard it by night amongst the wild elephants in the great forest of Brutenne, describes it as 'a sort of banging noise like a cooper hammering a cask;' and Major Skinner is of opinion that it must be produced by the elephant striking his sides rapidly and forcibly with his trunk. Mr. Cripps informs me that he has more than once seen an elephant, when surprised or alarmed, produce this sound by striking the ground forcibly with the point of the trunk, and this movement was instantly succeeded by raising the trunk, and pointing it in the direction whence the alarm proceeded, as if to ascertain by the sense of smell the nature of the threatened danger. As this strange sound is generally mingled with the ordinary bellowing and trumpeting of the herd, it is in all probability a device resorted to, not alone for warning their companions of some approaching peril, but also for the additional purpose of terrifying unseen intruders. Extravagant estimates are recorded of the height of the elephant. In an age when popular fallacies in relation to him were as yet uncorrected in Europe by the actual inspection of the living animal, he was supposed to grow to the height of twelve or fifteen feet. Even within the last century in popular works on natural history the elephant, when full grown, was said to measure from seventeen to twenty feet from the ground to the shoulder. At a still later period, so imperfectly had the facts been collated that the elephant of Ceylon was believed to 'excel that of Africa in size and strength.' But so far from equalling the size of the African species, that of Ceylon seldom exceeds the height of nine feet, even in the Hamburg-totte country, where the hunters agree that the largest specimens are to be found, and the ordinary herds do not average more than eight feet. Wolf, in his account



THE ASIATIC ELEPHANT.

of the Ceylon elephant, says he saw one taken near Jaffna which measured twelve feet and one inch high. But the truth is, that the general bulk of the elephant so far exceeds that of the animals which we are accustomed to see daily, that the imagination magnifies his unusual dimensions; and I have seldom or ever met with an unexperienced spectator who did not unconsciously over-estimate the size of an elephant shown to him, whether in captivity or in a state of nature. Major Denham would have guessed some which he saw in Africa to be sixteen feet in height; but the largest when killed was found to measure nine feet six inches. For a creature of his extraordinary height, it is astonishing how noiselessly and stealthily the elephant can make his escape from a pursuer. When suddenly disturbed in the jungle, he will burst away with a rush that seems to bear down all before him; but the noise sinks into absolute stillness so suddenly that a novice might well be led to suppose that the fugitive had only halted within a few yards of him, when further search would disclose that he had stolen silently away, making scarcely a sound in his escape; and, stranger still, leaving the foliage almost undisturbed by his passage."

Major Skinner communicated to Sir E. Tennant the following narrative of an adventure in the great central forest towards the north of Ceylon, and it will serve to convey an idea of how the herd will obey the orders of their leader:—

"The case you refer to struck me as exhibiting something more than ordinary brute instinct, and approached nearer to reasoning powers than any other instance I can now remember. I cannot do justice to the scene, although it appeared to me at the time to be so remarkable that it left a deep impression in my mind. In the height of the dry season in Neuera-Ka-lawa, you know the streams are all dried up, and the tanks nearly so. All animals are then sorely pressed for water, and they congregate in the vicinity of those tanks in which there may remain ever so little of the precious element. During one of those seasons, I was encamped on the bund or embankment of a very small tank, the water in which was so dried up that its surface could not have exceeded an area of 500 square yards. It was the only pond within many miles, and I knew that of necessity a very large herd of elephants, which had been in the neighbourhood all day, must resort to it at night. On the lower side of the tank, and in a line with the embankment, was a thick forest, in which the elephants sheltered themselves during the day. On the upper side and all around the tank there was a considerable margin of open ground. It was one of those beautiful, bright, clear, moonlight nights, when objects could be seen almost as distinctly as by day, and I determined to avail myself of the opportunity to observe the movements of the herd, which had already manifested some uneasiness at our presence. The locality was very favourable for my purpose, and an enormous tree projecting over the tank afforded me a secure lodgment in its branches. Having ordered the fires of my camp to be extinguished at an early hour, and all my followers to retire to rest, I took up my post of observation on the overhanging bough; but I had to remain for upwards of two hours before anything was to be seen or heard of the elephants, although I knew they were within 500 yards of me. At length, about the distance of 300 yards from the water, an unusually large elephant issued from the dense cover, and advanced cautiously across the open ground to within 100 yards of the tank, where he stood perfectly motionless. So quiet had the elephants become (although they had been roaring and breaking the jungle throughout the day and evening), that not a movement was now to be heard. The huge vidette remained in his position, still as a rock, for a few minutes, and then made three successive stealthy advances of several yards (halting for some minutes between each, with ears bent forward to catch the slightest sound), and in this way he moved slowly up to the water's edge. Still he did not venture to quench his thirst; for though his fore-feet were partially in the tank, and his vast body was reflected clear in the water, he remained for some minutes listening in perfect stillness. Not a motion could be perceived in himself or his shadow. He returned cautiously and slowly to the position he had at first taken up on emerging from the forest. Here in a little while he was joined by five others, with which he again proceeded as cautiously but less slowly than before, to within a few yards of the tank, and then posted his patrols. He then re-entered the forest and collected around him the whole herd, which must have amounted to between eighty and a hundred individuals, led them across the open ground with the most extra ordinary composure and quietness, till he joined the advanced guard, when he left them for a moment and repeated his former reconnoissance at the edge of the tank: after which, and having apparently satisfied himself that all was safe, he returned and obviously gave the order to advance, for in a moment the whole herd rushed into the water with a degree of unreserved confidence, so opposite to the caution and timidity which had marked their previous movements, that nothing will ever persuade me that there was not rational and preconcerted co-operation throughout the whole party, and a degree of responsible authority exercised by the patriarch leader.

"When the poor animals had gained possession of the tank (the leader being the last to enter), they seemed to abandon themselves to enjoyment without restraint or apprehension of danger. Such a mass of animal life I had never before seen huddled together in so narrow a space. It seemed to me as though they would have nearly drunk the tank dry. I watched them with great interest until they had satisfied themselves as well in bathing as in drinking, when I tried how small a noise would apprise them of the proximity of unwelcome neighbours. I had but to break a little twig, and the solid mass instantly took to flight like a herd of frightened deer, each of the smaller calves being apparently shouldered and carried along between two of the older ones. In drinking, the elephant, like the camel, although preferring water pure, shows no decided aversion to it when discoloured with mud; and the eagerness with which he precipitates himself into the tanks and streams attests his exquisite enjoyment of the fresh coolness, which to him is the chief attraction. In crossing deep rivers, although his rotundity and buoyancy enable him to swim with a less immersion than other quadrupeds, he generally prefers to sink till no part of his huge body is visible except the tip of his trunk, through which he breathes, moving beneath the surface, and only now and then raising his head to look that he is keeping the proper direction."

As regards the general sagacity of the elephant, although it has not been overrated in the instance of those whose powers have been largely developed in captivity, an undue estimate has been formed in relation to them whilst still untamed. The difference of instincts and habits renders it difficult to institute a just comparison between them and other animals. Cuvier is disposed to ascribe the exalted idea that prevails of their intellect to the feats which an elephant performs with that unique instrument its trunk, combined with an imposing expression of countenance; but he records his own conviction that in sagacity it in no way excels the dog and some other species of carnivora. If there be a superiority, I am disposed to award it to the dog, not from any excess of natural capacity, but from the higher degree of development consequent on his more intimate domestication and association with man. One remarkable fact was called to my attention by a gentleman who resided on a coffee-plantation at Raxava, one of the loftiest mountains of the Ambo-gammoa range. More than once during the terrific thunder-bursts that precede the rains at the change of each monsoon, he observed that the elephants in the adjoining forests hastened from under cover of the trees and took up their station in the open ground, where I saw them on one occasion collected into a group; and here, he said, it was their custom to remain till the lightning had ceased, when they retired again into the jungle. When free in his native woods, the elephant evinces rather simplicity than sagacity, and his intelligence seldom exhibits itself in cunning. The rich profusion in which nature has supplied his food and anticipated his every want, has made him independent of those devices by which carnivorous animals provide for their subsistence; and from the absence of all rivalry between himself and the other denizens of the plains, he is never required to resort to artifice for self-protection. For these reasons, in his tranquil and harmless life, he may appear to casual observers to exhibit even less than ordinary ability; but when danger and apprehension call for the exertion of his powers, those who have witnessed their display are seldom inclined to undervalue his sagacity.

An ordinary traveller seldom comes upon elephants unless after sunset, or towards daybreak, as they go or return from their nightly visits to the tanks; but when by accident a herd is disturbed by day they evince, if unattacked, no disposition to become assailants; and if the attitude of defence which they instinctively assume prove sufficient to check the approach of the intruder, no further demonstration is to be apprehended.

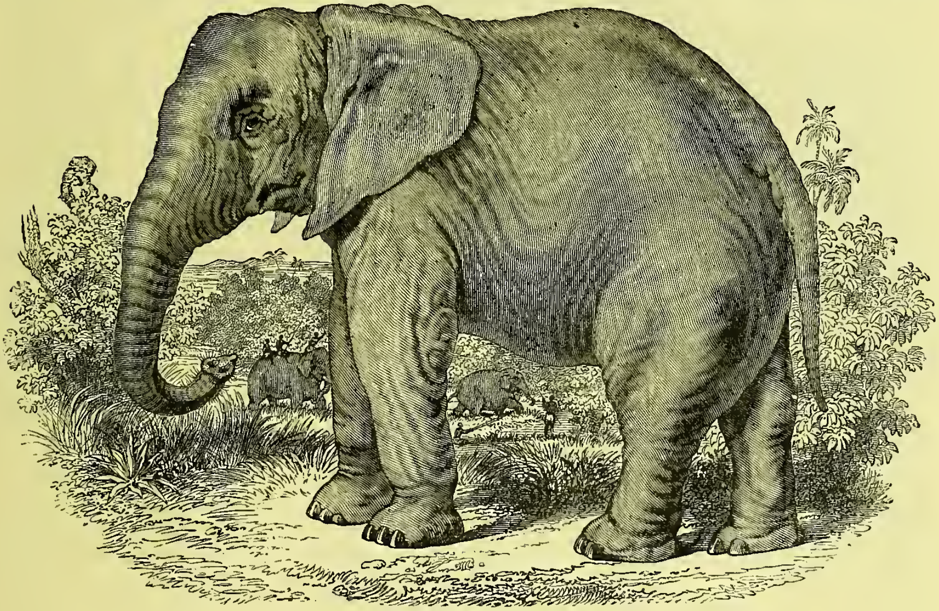
They evince the strongest love of retirement, and a corresponding dislike to intrusion. The approach of a stranger is perceived less by the eye, the quickness of which is not remarkable (besides which its range is obscured by the foliage), than by sensitive smell and singular acuteness of hearing; and the whole herd is put in instant but noiseless motion towards some deeper and more secure retreat. The effectual manner in which an animal of the prodigious size of the elephant can conceal himself, and the motionless silence which he preserves, is quite surprising; whilst beaters pass and re-pass within a few yards of his hiding-place he will maintain his ground till the hunter, creeping almost close to his legs, sees his little eyes peering out through the leaves, when, finding himself discovered, he breaks away with a crash, levelling the brushwood in his headlong career.

The following account of the African Elephant (*E. africanus*) is by Livingstone:—

"Finding a buffalo lying down, I went to secure him for our food. Three balls did not kill him, and, as he turned round as if for a charge, we ran for the shelter of some rocks. Before we gained them, we found that three elephants, probably attracted by the strange noise, had cut off our retreat on that side; they, however, turned short off, and allowed us to gain the rocks. We then saw that the buffalo was moving off quite briskly, and in order not to be entirely balked, I tried a long shot at the last of the elephants, and, to the great joy of my people, broke his fore-leg. The young men soon brought him to a stand, and one shot despatched him. On the following day, while my men were cutting up the elephant, great numbers of the villagers came to enjoy the feast. We were on the side of a fine green valley, studded here and there with trees, and cut by numerous rivulets. I had retired from the noise, to take an observation among some rocks of laminated grit, when I beheld an elephant and her calf at the end of the valley, about two miles distant. The calf was rolling in the mud, and the dam was standing fanning herself with her great ears. As I looked at them through my glass, I saw a long string of my own men appearing on the other side of them, and Sekwebu came and told me that these had gone off, saying, 'Our father will see to-day what sort of men he has got.' I then went higher up the side of the valley, in order to have a distinct view of their mode of hunting. The goodly beast, totally unconscious of the approach of an enemy, stood for some time suckling her young one, which seemed about two years old; they then went into a pit containing mud, and smeared themselves all over with it, the little one frisking about his dam, flapping his ears and tossing his trunk incessantly, in elephantine fashion. She kept flapping her ears and wagging her tail, as if in the height of enjoyment. Then began the piping of her enemies, which was performed by blowing into a tube, or the hands closed together, as boys do into a key. They call out, to attract the animals' attention—

'O chief! chief! we have come to kill you;
O chief! chief! many more will die besides you, &c.
The gods have said it,' &c. &c.

Both animals expanded their ears and listened, then left their bath as the crowd rushed towards them. The little one ran forward towards the end of the valley, but, seeing the men there, returned to his dam. She placed herself on the danger side of her calf, and passed her proboscis over it again and again, as if to assure it of safety. She frequently looked back to the men, who kept up an incessant shouting, singing, and piping; then looked at her young one and ran after it, sometimes sideways, as if her feelings were divided between anxiety to protect her offspring and desire to revenge the temerity of her persecutors. The men kept about a hundred yards in her rear, and some that distance from her flanks, and continued thus until she was obliged to cross a rivulet. The time spent in descending and getting up the opposite bank allowed of their coming up to the edge, and discharging their spears at about twenty yards distance. After the first discharge, she appeared with her sides red with blood, and, beginning to flee for her own life, seemed to think no more of her young. I had previously sent off Sekwebu with orders to spare the calf. It ran very fast, but neither young nor old ever enter into a gallop; their quickest pace is only a sharp walk. Before Sekwebu could reach them, the calf had taken refuge in the water, and was killed. The pace of the dam gradually became slower. She turned with a shriek of rage, and made a furious charge back among the men. They vanished at right angles to her course, or sideways, and, as she ran straight on, she went through the whole party, but came near no one, except a man who wore a piece of cloth on his shoulders. Bright clothing is always dangerous in these cases. She charged three or four times, and, except in the first instance, never went farther than one hundred yards. She often stood, after she had crossed a rivulet, and faced the men, though she received fresh spears. It was by this process of spearing and loss of blood that she was killed, for at last, making a short charge, she staggered round and sank down dead in a kneeling posture. I did not see the whole hunt, having been tempted away by both sun and moon appearing unclouded. I turned from the spectacle of the destruction of a noble animal, which might be made so useful in Africa, with a feeling of sickness, and it was not relieved by the recollection that the ivory was mine, though that was the case. I regretted to see them killed, and more especially the young one, the meat not being at all necessary at that time; but it is right to add that I did not feel sick when my own blood was up the day before. We ought, perhaps, to judge those deeds more leniently in which we ourselves have no temptation to engage. Had I not been previously guilty of doing the very same thing, I might have prided myself on superior humanity when I experienced the nausea in viewing my men kill these two. The elephant first killed was a male, not full-grown; his height at the withers 8 feet 4 inches; circumference of the fore-foot 44 inches × 2 = 7 feet 4 inches. The female was full-grown, and measured in height 8 feet 8 inches, circumference of the fore-foot 48 inches × 2 = 8 feet (96 inches.) We afterwards found that full-grown male elephants of this region ranged in height at the withers from 9 feet 9 inches to 9 feet 10 inches, and the circumference of the fore-foot to be 4 feet $9\frac{1}{2}$ inches × 2 = 9 feet 7 inches. These details are given because the general rule has been observed, that twice the circumference of the impression made by the fore-foot on the ground is the height of the animal. The print on the ground being a little larger than the foot itself, would thus seem to be an accurate mode of measuring the size of any elephant that has passed; but the above measurements show that it is applicable only to full-grown animals. The greater size of the African elephant in the south would at once distinguish it from the Indian one; but here they approach more nearly to each other in bulk, a female being about as large as a common Indian male. But the ear of the African is an external mark which no one will mistake even in a picture. That of the female now killed was 4 feet 5 inches in depth, and 4 feet in horizontal breadth. I have seen a native creep under one so as to be quite covered from the rain. The ear of the Indian variety is not more than a third of this size. The representation of elephants on ancient coins shows that this important characteristic was distinctly recognised of old. Indeed, Cuvier remarked that it was better known by Aristotle than by Buffon. Having been anxious to learn whether the African elephant is capable of being tamed, through the kindness of my friend Admiral Smyth I am enabled to give the reader conclusive evidence on this point. In the two medals furnished from his work, 'A Descriptive Catalogue of his Cabinet of Roman and Imperial Large Brass Medals,' the size of the ears will be at once noted as those of the true African elephant. They were even more docile than the Asiatic, and were taught various feats, as walking on ropes, dancing, &c. One of the coins is of Faustina, senior,



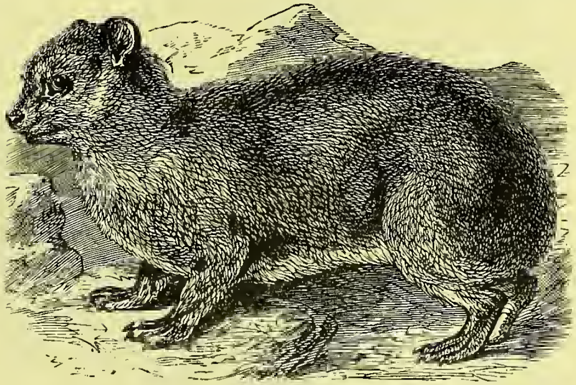
THE AFRICAN ELEPHANT.

the other of Septimus Severus, and struck A.D. 197. These elephants were brought from Africa to Rome. The attempt to tame this most useful animal has never been made at the Cape, nor has one ever been exhibited in England. There is only one very young calf of the species in the British Museum. The abundance of food in this country, as compared with the south, would lead one to suppose that animals here must attain a much greater size; but actual measurement now confirms the impression made on my mind by the mere sight of the animals, that those in the districts north of 20° were smaller than the same races existing southward of that latitude. The first time that Mr. Oswell and myself saw full-grown male elephants on the river Zouga, they seemed no larger than the females (which are always smaller than males) we had met on the Limpopo. There they attain a height of upwards of twelve feet. At the Zouga, the height of one I measured was eleven feet four inches, and in this district nine feet ten inches. There is, however, an increase in the size of the tusks as we approach the equator. Unfortunately, I never made measurements of other animals in the south; but the appearance of the animals themselves in the north at once produced the impression on my mind referred to, as to their decrease in size. When we first saw Koo-doos, they were so much smaller than those we had been accustomed to in the south, that we doubted whether they were not a new kind of antelope; and the leche, seen nowhere south of 20°, is succeeded by the poku as we go north. This is, in fact, only a smaller species of that antelope, with a more reddish colour. A great difference in size prevails also among domestic animals; but the influence of locality on them is not so well marked. The cattle of the Batoka, for instance, are exceedingly small and very beautiful, possessing generally great breadth between the eyes, and a very playful disposition. They are much smaller than the aboriginal cattle in the south; but it must be added that those of the Baroke valley, in the same latitudes as the Batoka, are large. It is a little remarkable, that a decrease in size should occur where food is the most abundant; but tropical climates seem unfavourable for the full development of either animals or man. It is not from want of care in the breeding, for the natives always choose the larger and stronger males for stock; and the same arrangement prevails in nature, for it is only by overcoming their weaker rivals that the wild males obtain possession of the herd. Invariably they show the scars received in battle. The elephant we killed yesterday had an umbilical hernia as large as a child's head, probably caused by the charge of a rival. The cow showed scars received from men; two of the wounds in her side were still unhealed, and there was an orifice six inches long, and open, in her proboscis, and as it was about a foot from the point, it must have interfered with her power of lifting water. In estimating the amount of food necessary for these and other large animals, sufficient attention has not been paid to the kinds chosen. The elephant, for instance, is a most dainty feeder, and particularly fond of certain sweet-tasted trees and fruits. He choses the mohonono, the mimosa, and other trees which contain much saccharine matter, mucilage, and gum. He may be seen putting his head to a lofty palmyra, and swaying it to and fro to shake off the seeds; he then picks them up singly, and eats them. Or he may be seen standing by the masuka and other fruit-trees, patiently picking off the sweet fruits one by one. He also digs up bulbs and tubers, but none of these are thoroughly digested. Bruce remarked upon the undigested bits of wood seen in their droppings, and he must have observed, too, that neither leaves nor seeds are changed by passing through the alimentary canal. The woody fibre of roots and branches is dropped in the state of tow, the nutritious matter alone having been extracted. This capability of removing all the nourishment, and the selection of those kinds of food which contain great quantities of mucilage and gum, accounts for the fact that herds of elephants produce but small effect upon the vegetation of a country, quality being more requisite than quantity. The amount of internal fat found in them makes them much prized by the inhabitants, who are all very fond of it, both for food and ointment."

We may be permitted here to notice a third species (*E. primigenius*), which, though extinct, has become so almost in modern times. The frozen carcases of this species were found near the mouth of the Lena, in 1805, still covered with hairy skin; and very recently another example, with many of the soft parts preserved, has been found.

ORDER IX.—THE CONIES (*Hyracoidea*).

THIS order, too, contains but a single genus, but unlike the last, it is not represented by any extinct or fossil forms. There are ten or twelve species known. Linnæus knew but one, and he placed it among the Rodents. Cuvier thought it should belong to the Pachyderms, but for many weighty anatomical reasons it seems far preferable to place it in an order by itself between the Elephants and Rodents. The animals are of small size, presenting somewhat the appearance of marmots. Bruce describes the one he met with in Egypt as like a wild rabbit. The nose is blunt, the upper lip is prehensile, while the whole body is covered with hair. There are a few scattered longish bristles. The toes are long and bent, with flat claws. The tail is either short or none. The incisors in the upper jaw are long, triangular, and like little tusks; those in the lower jaw are normal. There are either no canines or they are rudimentary; the molars have nearly the same form as those of Rhinoceros. In some species the malar bone forms a ring behind the orbit. Dr. J. E. Gray divides the genus Hyrax into three—Hyrax, Euhyrax, and Dendrohyrax, and enumerates thirteen species. The Klipdas, or Cape Hyrax (*H. capensis*), has bred in the London Zoological Gardens, and is found at the Cape of Good Hope; H. brucei occurs in Abyssinia, H. bocagei in Angola, H. arboreus, in South Africa and Mozambique. Dr. Kirk says it was common at Mozambique, on rocky hill-sides, living in colonies. It was caught by spring traps, and was good to eat.



THE CONEY (*Hyrax siniaticus*).

The Coney (*H. siniaticus*) is found throughout the Holy Land, and Canon Tristram gives a good account of its manners and habits in his interesting "Natural History of the Bible." The geographical range of these little animals is all over Africa, as far north as Syria. But though one species (H. dorsalis) is met with at Fernando Po, no species has as yet been found on any of the islands on the east coast of Africa.

ORDER X.—ANIMALS THAT GNAW (*Rodentia*).

THIS order contains by far the largest number of recent mammals. By the latest census, while there are about 450 bats, 375 carnivores, 270 hoofed mammals, there are upwards of 775 rodents, and in all probability there are still new species to be discovered among the squirrels and mice. The order may be characterised as consisting of mammals with incisor teeth in both jaws, with the exception of the hares and pikas (which have four incisors in the upper jaw); there are two incisors in the upper, and two in the lower. These are large, incurved, and destitute of roots, being so constructed, and the jaws so articulated, as to effect the reduction of the food to small particles by acts of rapid and continued gnawing (whence the name of the order). There are no canine teeth; the molars are separated by a wide interval from the incisors, and are rarely more than four on each side of both jaws; the feet are clawed, and in most pentadactylous. They live chiefly or exclusively on vegetable food—often on the bark of trees, roots, &c. They are commonly of small size, and exceedingly prolific. The Beaver and the Capybara may be regarded as the giants of the order. Some few perform wonderful migrations, after the manner of the swallows among birds. Some of them build pretty bird-like nests, and a few manifest their constructive instinct in association. Many of them hibernate on the approach of cold. They are among the most universally distributed of all the mammals. Although nearly absent from Australasia and from Madagascar, they are otherwise pretty evenly distributed over the world. It is scarcely the place to refer to the difficulties in classifying this immense order. It readily falls into two sub-orders—(1), those with two incisor teeth in the upper jaw; (2), those with four or a duplicate set; and in the divisions into families we, with scarcely any deviation, follow Professor Lilljeborg (Systematisk öfversigt af de gnagande däggdjuren (Glires), Upsala, 1866).

SUB-ORDER 1.—SIMPLICIDENTATI.

FAMILY LIII.—THE MICE (*Muridæ*).

The Rats and Mice and related forms are in number more than three hundred, and are placed in some thirty-eight genera. To treat of these in detail would far exceed our limits. Of the genus Mus about 120 species are known, none of them being found in either North or South America. The Black Rat (*Mus rattus*) was at one time common in Europe, but has now become very rare in Great Britain and in many parts of the Continent, having been expelled by the brown rat. It has a home, however, still among some of the islands on the north-west coast of France. In has been imported into America in ships.

THE BLACK RAT (*Mus rattus*).

Some of our readers may recollect that on the left bank of the Rhine, not far from where the Nahe flows into that river, there stands the Mause thurm, which, as tradition will have it, derived its name from the well-known legend of the cruel Archbishop Hatto of Mayence. Having caused a number of famishing people to collect in his barn—in Southey's words—

> "Then when he saw it could no more,
> Bishop Hatto he made fast the door;
> And while for mercy on Christ they call,
> He set fire to the barn and burnt them all."

But in the morning, as a judgment, the rats came—doubtless, from the date, they must have been this species, though they appear to have had the instincts of the brown rat. Up to the bishop's house they marched, and into the bishop's room they came—

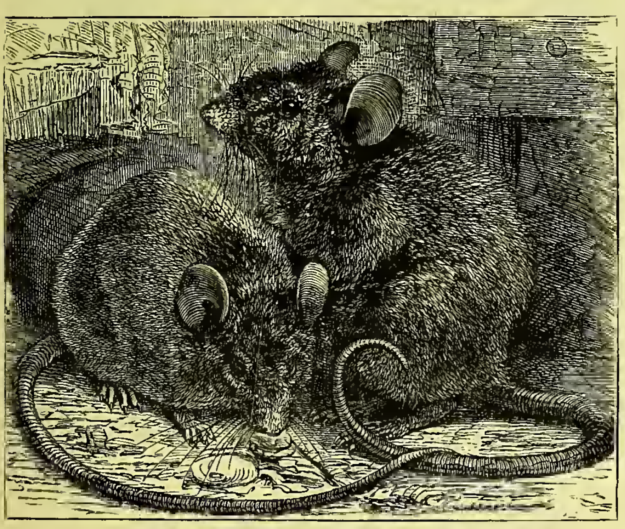
> "In at the windows, and in at the door,
> And through the walls by thousands they pour;
> And down through the ceiling, and up through the floor,
> From the right and the left, from behind and before:
> From within and without, from above and below,
> And all at once to the bishop they go.
> They have whetted their teeth against the stones,
> And now they pick the bishop's bones;
> They gnawed the flesh from every limb,
> For they were sent to do judgment on him."

The Brown Rat (*M. decumanus*) is thought to have been first noticed in Europe about 1727, coming from Persia, and entering Eastern Russia by way of Astracan. A very few years later it was to be found in France and England, and it is now spread to every part of the world frequented by European shipping. Under favourable circumstances they increase to an enormous extent. Thus, in the knackers' yards at Montfauçon, if the carcases of dead horses were thrown during the day in a corner, the next morning they would be found stripped of their flesh. An old proprietor of one of these slaughter-houses had a certain space entirely surrounded by walls, with holes only large enough for the ingress and egress of rats. Within this inclosure he left the carcases of two or three horses, and when night came, he went quietly with his workmen, stopped up the holes, and then entered into the inclosure, with a stick in one hand and a lighted torch in the other. The animals covered the ground so thickly that a blow struck anywhere did execution. By repeating the process after intervals of a few days, he killed 16,050 rats in the space of one month, and 2,650 in a single night.

THE BROWN RAT (*Mus decumanus*).

The Alexandria Rat (*M. alexandrinus*), supposing it to be a different species from the black rat, holds its own in Egypt against the brown rat, and has a tendency to spread westward. It is now found in Southern Italy, is said to be the only rat in Sardinia, and now and then is found in British ports, having come in corn and cotton vessels.

While the rats have more or less plump feet, and 200 rows of scales in their tails, the mice have thin delicate feet, and only 180 rows of scales in their tails. The Common, or House Mouse (*M. musculus*), is too well known to need description. It seems to have followed man everywhere. An Albino variety is not rare, and a red-brown variety is common about Florence. Has this any affinity to the Mus poschivianus of Fatio, which feeds on tobacco? An extraordinary form will be found figured on Plate 41, Mammalia, of the "Proceedings of the Zoological Society," in which the fur is absent, and the skin is arranged in folds like that of a rhinoceros.

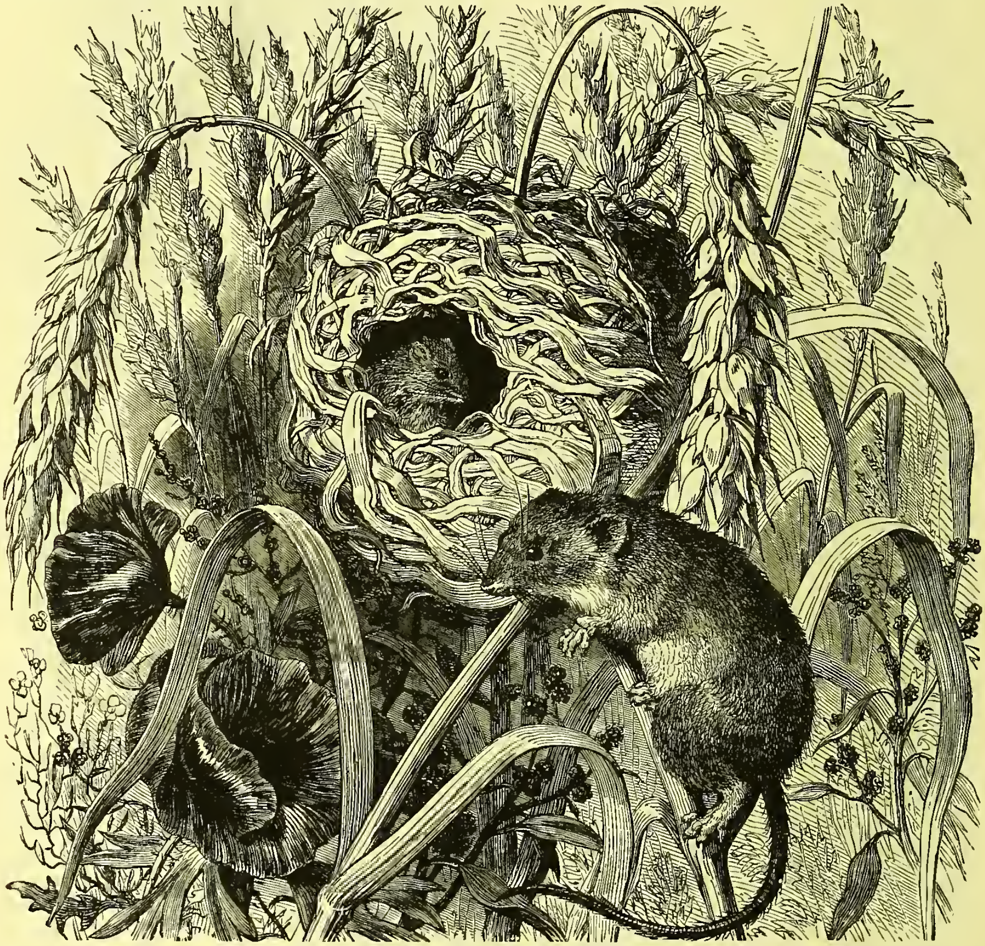


THE HOUSE MOUSE (*Mus musculus*).

The Long-tailed Field Mouse (*M. sylvaticus*) is common all over Europe, and without the slightest doubt is the mouse addressed by Burns as a—

"Wee, sleekit, cow'rin', timorous beastie."

The Harvest Mouse (*M. minutus*) is found probably all over Europe. It is not common in England, and is more frequent in Belgium. White, of Selborne, in writing to Pennant, says:—"They build their nests amidst the straws of the corn above the ground, and sometimes in thistles. They breed as many as eight at a litter, in a little round nest composed of the blades of grass or wheat. One of these I procured this autumn, most artificially platted, and composed of the blades of wheat, perfectly round, and about the size of a cricket-ball, with the aperture so ingeniously closed that there was no discovering to what part it belonged. It was so compact and well filled that it would roll across the table without being discomposed, though it contained eight little mice that were naked and blind. As this nest was perfectly full, how could the dam come at her litter respectively so as to administer a teat to each? Perhaps she opens different places for that purpose, adjusting them again when the business is over; but she could not possibly be contained herself in the ball with her young, which, moreover, would be daily increasing in bulk. This wonderful procreant cradle—an elegant instance of the efforts of instinct—was found in a wheat-field, suspended in the head of a thistle." The food of this little mouse consists of corn and grass seeds, insects, and earth-worms. Of insects it is very fond.



THE HARVEST MOUSE (*Mus minutus*) NEST BUILDING.

Of most of the other genera belonging to this family a bare enumeration must suffice. Lasiomys afer (Peters), comes from Guinea; Acanthomys spinosissimus (Peters); Cricetomys gambianus; Saccostomus fuscus (Peters); are all from Mozambique.

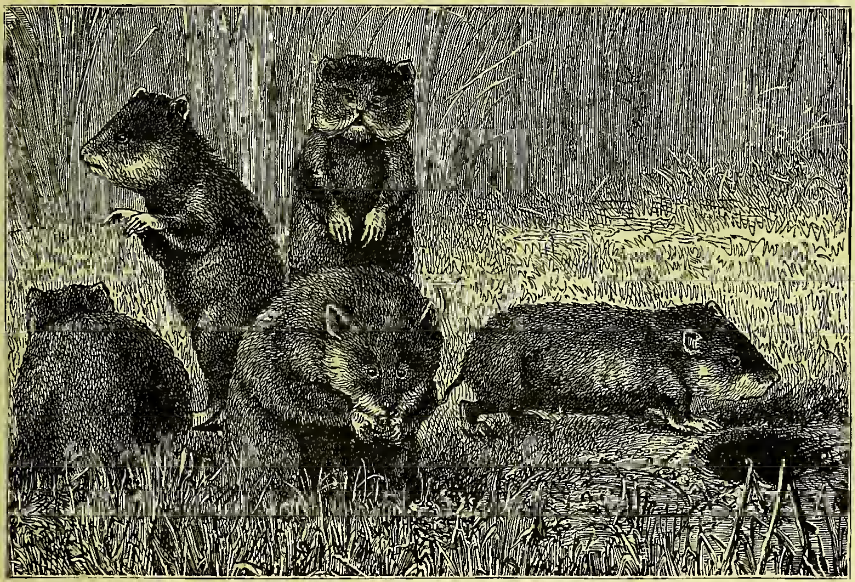
The Hamster (*Cricetus frumentarius*) occurs throughout the central and northern parts of Europe. It comes as far west as Alsace, but is not found in Switzerland. It constructs with much art a burrow, divided into several chambers, where it lays up a store of roots, grass, and corn, on which to live during the winter. This store has sometimes been found to weigh 100 lbs. While it passes the cold weather in a nest of straw, having first carefully closed the entrance, it, in extreme cold, becomes torpid. It is said sometimes to attack mice.

C. phœus is found on the borders of the Caspian Sea, Persia, Tartary. In the Crimea it is noted for its depredations on the grain stores. It feeds principally on grain.

Pseudomys australis (Gray) is from New South Wales, and the various species of Hapalotis, are found in New Holland. One of Gould's beautiful plates represents H. constructor, which builds a nest like a little beehive (" Mammals of Australia," Pl. 8).

Phlœmys cummingii is from the Philippines, Dendromys melanotis and D. mesomelas from South Africa. Steatomys pratensis (Peters) and Pelomys fallax (Peters) are from Mozambique.

Reithrodon humilis, and some allied species, are found over the southern parts of North America and South America to Terra del Fuego. Hesperomys is an exclusively American genus, taking the place there of the Old World genus Mus. The difference in the structure of the molar teeth is very great. In the American rats the molar teeth are complex, with tubercles in two rows, and, instead of as in Mus the enamel being uniform, the folds in Hesperomys more or less alternate when worn. Nearly ninety species are known. Of the American mice belonging to Holochilus, Neotoma, Oxymicterus, nor to Myxomys salvinni can we allude.



THE HAMSTER *(Cricetus frumentarius).*

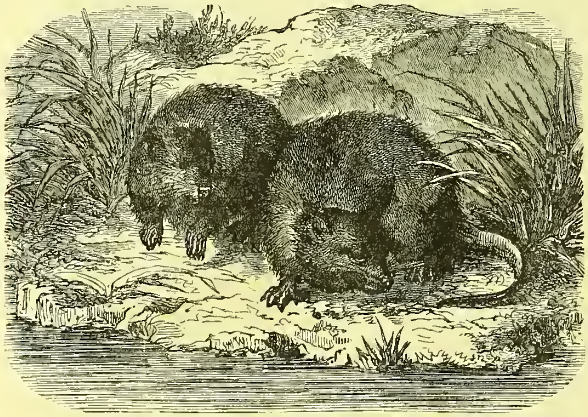
Of the African mice allied to Meriones we must mention Meriones indicus. They are very numerous about cultivated lands, and particularly destructive to wheat and barley crops, of which they lay up considerable hoards in spacious burrows near the scenes of their plunder. They cut the culms of the ripening corn just beneath the ears, and convey them thus entire to their common subterraneous repository, which, when filled, they carefully close, and do not open for use till supplies abroad become distant and scarce. Grain of all kinds is their favourite food; but, in default of this, they have recourse to the roots of grass and other vegetables. About the close of day they issue from their burrows, and traverse the plains in all directions to a considerable distance. When eating, they sit on their hind legs like a squirrel, holding the food between their fore-feet. They never show themselves by day, neither do they commit depredations within doors.

A tribe of low Hindoos, called Kunjers, whose occupation is hunting, go in quest of these animals at proper seasons, to plunder their hoards of grain; and often, within the space of twenty yards square, find as much corn in the ear as could be crammed into a common bushel. They inhabit dry situations, and are often found at the distance of some miles out of the reach of water to drink. In confinement, this animal soon becomes reconciled to its situation, and is docile; it sleeps much in the daytime, but, when awake feeds as freely as by night. The Hindoos above mentioned esteem it good and nutritious food.

M. meridianus is the only European species; it inhabits the districts between the Volga and Jaik.

Sminthus nordmanni is an interesting species discovered in the Crimea in 1840 by Nordmann. Blasius says it also occurs in Hungary, Sweden, and Russia. Hydromys chrysogaster, and several other species occur in Australia and Tasmania.

Of the Arvicolini, the Beaver Rat (*Fiber zibethicus*) first calls for notice. It is a native of North America, and, in general appearance, it resembles the common water rat, the size excepted. In the length of the head and body it measures about fourteen inches, that of the tail being eight or nine. The fur, which is much like that of the beaver, is dark umber brown, passing into brownish-yellow on the under parts; pied, and even white, varieties are sometimes seen. The hind feet are not webbed; the tail is compressed laterally, broadest in the middle, and covered with a thin sleek coat of short hairs; larger hairs run along the acute margins. The range of this animal is from latitude 30°, as high north as 69°. Small grassy lakes or swamps, or the grassy borders of slow streams, are its favourite haunts. Roots, tender shoots, and leaves are its principal food, to which it adds fresh-water mussels. It swims and dives well, plunging into the water on the least alarm, and diving instantaneously on perceiving the flash of a gun. In the autumn, before the shallow lakes and swamps freeze over, this animal builds its house of mud, giving it a conical form, and a sufficient base to raise the chamber above the water. The entrance is under water. When ice forms over the surface of the swamp, the animal makes breathing holes through it, which it protects from the frost by a covering of mud. In severe winters, however, these holes freeze up in spite of the coverings, and many of the animals die.


THE MUSK RAT (*Fiber zibethicus*).

The Indians kill these animals by spearing them through the walls of their houses, making their approach with great caution, for they take to the water when alarmed by a sound on the ice. An experienced hunter is so well acquainted with the direction of the chamber and the position in which its inmates lie, that he can transfix four or five at a time. The principal seasons for taking them are the autumn, before the snow falls, and the spring, after it has disappeared, but while the ice is still entire. In the winter time the depth of snow prevents the houses and breathing-holes from being seen. One of the first operations of the hunter is to stop all the holes with the exception of one, at which he stations himself to spear the animals that have escaped the being struck in their houses, and that have come hither to breathe.

In the summer they burrow on the banks of the lakes, making branched canals many yards in extent, and forming their nest in a chamber at the extremity, in which the young are brought forth. When its house is attacked in the autumn, it retreats to those passages, but in the spring they are frozen up. The animal may be frequently seen on the shore of small muddy islands, sitting in a rounded form, and not easily to be distinguished from a piece of earth, until, on the approach of danger, it suddenly plunges into the water. In the act of diving, when surprised, it gives a smart blow to the water with its tail. Its flesh is eaten by the natives, though it has a strong musky flavour. The fur at one time was much used for hat-making, and hundreds of thousands of skins have been annually imported into Great Britain.

F. osoyoosensis is a smaller species described by Mr. Lord from Lake Osoyoos in the Rocky Mountains.

The Voles (*Arvicola*) constitute a numerous group, some fifty species being known. The

Water Rat (*A. amphibius*) inhabits nearly the whole of Central and Northern Europe. Though not uncommon in England and Scotland, it appears not yet to have been found in Ireland. Several marked varieties are known.

This animal inhabits the banks of rivers, streams, ponds, and even ditches, in the banks of which it burrows and breeds. Its retreat is, however, sometimes at a great distance from the water. It is supposed to be entirely a vegetable feeder, roots and subaqueous plants being its staple. It has been said to feed on worms, frogs, small fish, and the fry of fish generally, among other animal food, and has been accused of being the enemy of the fish-pond and the trout-stream. But the charge is held to be false. The water rat is often, indeed, devoured by the pike, and probably by the very large trouts. Mr. Bell supposes that the libel is owing to this animal being confounded by inaccurate observers with the common brown rat, which often haunts ditches and mill-tails, feeding freely on all sorts of animal substances, and taking the water boldly.

A very interesting writer says: "We have seen water-rats cross a wide meadow, climb the stalks of the dwarf beans, and, after detaching the pods with their teeth, shell their contents in the most workmanlike manner. They will mount vines and feed on the grapes; and a friend informs us that on one occasion he saw a water-rat go up a ladder which was resting against a plum-tree and attack the fruit. If a garden is near the haunts of water-rats, it is necessary to watch narrowly for the holes underneath the walls, for they will burrow under the foundation with all the vigour of sappers and miners. Such is the cunning with which they will drive their shafts that they will ascend beneath a stack of wood, a heap of stones, or any other object which will conceal the passage by which they obtain an entrance."

THE SHORT-TAILED FIELD MOUSE (*Arvicola arvalis*).

The Short-tailed Field Mouse (*A. arvalis*) is found throughout Europe to Siberia. Small and insignificant as this animal appears to be, there is scarcely a species among the rodents more destructive to our fields, gardens, and woods. In the corn-field, the rick-yard, the granary, and in extensive plantations, its depredations are often severe, and even calamitous. Of the damage effected by a multitude of these animals we give a single instance. In the year 1814 the whole, both of Dean and New Forest, appeared to be largely stocked with mice; at least, wherever the large furze-brakes in the open parts had been burnt, their holes and runs covered the surface. Hayward Hill, a new plantation of about 500 acres, in the Forest of Dean, was particularly infested. This inclosure, after being properly fenced, was planted with acorns in 1810, and in the following spring about one-third came up, the rest of the seed having been destroyed principally by mice. The young shoots of the natural hollies of the district, which had been cut down to favour the plantation, were not attacked by the mice in the following winter, though their runs were numerous. In the autumn of the succeeding year a large quantity of five years' old oaks and chestnuts, with ash, larch, and fir, were planted in the inclosure. In the winter the destruction began, and numbers of the hollies, then two, three, or more feet in height, were barked round from the ground to four or five inches upwards, and died. In the succeeding spring a number of the oaks and chestnuts were found dead; and, when they were pulled up, it appeared that the roots had been gnawed through two or three inches below the surface of the ground; many were also barked round and killed, like the holly-shoots, whilst others, which had been begun upon, were sickly. The evil now extended to the other inclosures, and becoming very serious both in Dean Forest and the New Forest, cats were turned out, the bushes, ferns, rough grass, and other plants were cleared off, to expose the mice to beasts and birds of prey; poisons in great variety were laid, and seven or eight different sorts of traps were set for them, some of which succeeded very well. These were, however, superseded by the plan of a ratcatcher, who, having been employed to capture the mice, had observed, on going to work in the morning, that some of them had fallen into wells or pits, accidentally formed, and could not get out again, many of them dying from hunger or fatigue in endeavouring to climb up the sides.

Such pits were therefore tried on his recommendation. They were at first made three feet deep, three long, and two wide; but these were found to be unnecessarily large, and after various experiments, it appeared that they answered best when from eighteen to twenty inches deep at the bottom, about two feet in length, and one foot and a half in width, and at top only eighteen inches long and nine wide; or so wide as would allow of the earth being got out of a hole of that depth, for, the wider they were below, and the narrower above, the better they answered their purpose. They were made about twenty yards asunder, or, where the mice were less numerous, thirty yards apart. Nearly 30,000 mice were speedily caught by this method in Dean Forest, and in the New Forest about 10,000 more. It was believed that a far greater number had been taken out of the holes, either alive or dead, by stoats and weazels, and by kites, owls, crows, jays, and magpies.

The Italian variety (*A. savii*) is in Italy equally destructive and numerous. Prince Bonaparte relates that on a single farm in the neighbourhood of Rome 11,000 were killed in one season.

THE LEMMING (*Myodes lemnus*).

The Norway Lemming (*Myodes lemnus*) inhabits the mountain districts of Norway and Lapland, and sometimes visit Sweden. At ordinary times the traveller will come across them in twos and threes scuddling away like young rabbits; but "they sometimes march like the army of locusts so emphatically described by the prophet Joel, destroy every root of grass before them, and spread universal desolation; they infect the very ground, and cattle are said to perish which taste of the grass which they have touched. They march by myriads in regular lines; nothing stops their progress—neither fire, torrents, lake, nor morass. They bend their course straight forward with most amazing obstinacy; they swim over the lakes; the greatest rock gives them but a slight check; they go round it, and then resume their march directly on without the least division. If they meet a peasant they persist in their course, and jump as high as his knees in defence of their progress; are so fierce as to lay hold of a stick and suffer themselves to be swung about before they quit their hold; if struck, they turn about and bite, and will make a noise like a dog.

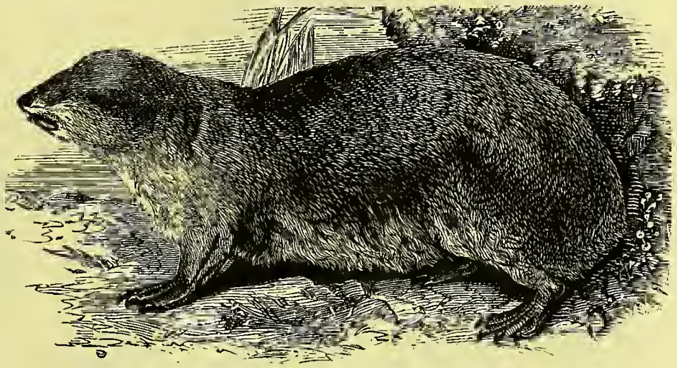
"They are the prey of foxes, lynxes, and ermines, who follow them in great numbers. At length they perish, either through want of food, or by destroying one another, or in some great water, or in the sea. They are the dread of the country. In former times spiritual weapons were exerted against them; the priest exorcised and had a long form of prayer to arrest the evil; happily, it does not occur frequently—once or twice in twenty years."

The Northern Lemming (*M. torquatus*) is found in Northern Asia, Siberia, and in Northern American Greenland. Near the Pole these lemmings become white in winter. Sir John Ross states that one of these animals having been shut up for several days, during one of his Polar voyages, escaped during the night, but was found next morning on the ice near the vessel. When its cage was lowered, which it recognised in the hands of its keeper, it re-entered immediately. It lived several months in the cabin, and kept its summer fur on. Having found it did so, Sir J. Ross was induced to try the effect of cold and exposure for several days. It was placed, in consequence, in a box on the tiller. On the 1st of February and the following morning, after having been exposed to a temperature of twenty degrees below zero, the fur on its cheeks and one place on each shoulder became perfectly white. The following day the white patches on each shoulder were considerably enlarged; the hinder part of the body and the flanks became a dirty white. During the four succeeding days the change continued, and about the end of the week the lemming was entirely white, with the exception of a deep band traversing the shoulders, which extended itself behind to the middle of the back, and formed a kind of saddle, where the colour remained the same. The thermometer continued to range between thirty and forty degrees below zero till the 18th of the month, without producing any other change, at which time the poor animal suffered much, and at length perished from the rigour of the weather. On examining its skin it appeared that all the white parts of the fur were longer than the parts which had not changed.

Following A. Milne-Edwards, we place here Myospalax aspalax (*Mus aspalax*, Pall), with a naked nose, small eyes, with ears forming only a mere margin to the ear opening, and with the three middle fingers with long, strong, sickle-shaped claws. It is found on the Altai Mountains, and was formerly placed in the next family. A. Milne-Edwards also describes M. fontainerii from Pekin and M. armandii from Mongolia.

FAMILY LIV.—THE MOLE RATS (*Spalacidæ*).

The Mole Rats are found scattered over the Old World. They have short, rat-like bodies, with the fore feet stouter than the hind, often adapted for digging; little or no tail; no outer ears; eyes very small, often hidden. Ellobius talpinus is found in Southern Russia and South Siberia. Spalax typhlus has no visible eyes, the skin often passing over them. It is about the size of a common rat. It lives underground. It is gregarious, and its burrows are clustered together. Its favourite localities are rich level plains. Its burrows consist of galleries at a little distance below the surface of the earth, which communicate with chambers sunk to a greater depth. From its galleries it drives lateral passages in search of roots, particularly of bulbous ones, on which it feeds. According to Rzaczinski, it also devours grain, of which it amasses a store in its burrow for winter consumption. Its movements are sudden and quick, but irregular; and it passes along with equal ease, both backwards and forwards. It burrows very expeditiously. In the morning it often quits its retreat and basks with its mate in the sun. At the least noise it raises its head to listen, and in a menacing attitude. When attacked, it snorts and gnashes its teeth, and defends itself resolutely, inflicting severe wounds. The people of the Ukraine have a superstition that the hand which has suffocated one of these animals, and has been bitten by it, is gifted with the virtue of curing the disease of the throat called goitre. It is found throughout Southern Russia, and in Hungary and Greece.



THE MOLE RAT (*Spalax typhlus*).

Rhizomys deccan is an animal about the size of a rabbit, found in Malacca, which is fond of feeding on the roots of the bamboo cane. The tail is destitute of hairs, except at the root. Several other species are known. A small one, R. splendens, is from Abyssinia.

The Sand Mole (*Bathyergus suillus*) lives on the sand-hills in the Cape district. It has large digging claws, and it feeds on roots.

The Little Cape Mole (*Geosychus capensis*) is about the size of a rat; is of a greyish colour, with a black head. It lives at the Cape of Good Hope. In the gardens of Cape Town it is known by its burrowing propensities.

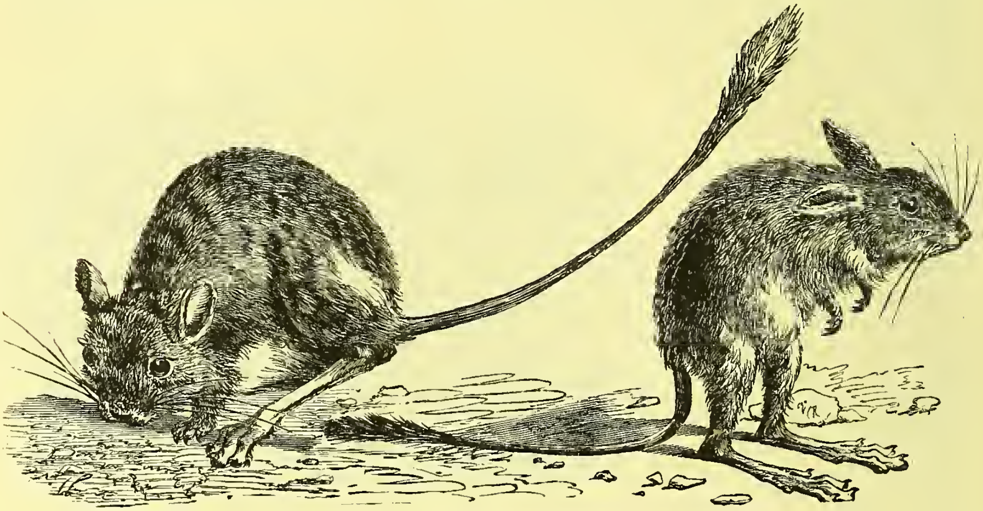
Heliophoblius argenteo-cinereus (Peters) is found at Mozambique.

FAMILY LV.—THE JERBOAS (*Dipodidæ*).

The Jerboas form a well-marked section of the Rodents, in which the fore feet are short, the hind feet long and saltatory; the tail is long and furnished with long hair; the eyes are large and prominent. In Jaculus the tibia and fibula are united.

The Jerboa (*Dipus sagitta*) inhabits Southern Russia and the Steppes between the Volga and Don, extending to Baikal.

The Egyptian Jerboa (*D. ægyptius*) lives in societies, burrowing deep into the sandy deserts of Egypt, Nubia, Arabia, Barbary, and Tartary. Dry, hard, and clayey ground is preferred by the jerboas for their habitations. In this they very speedily dig their burrows, using their teeth to aid their fore feet, and flinging the earth back with their hind feet, so as to form a heap at the entrance. The burrows are many yards long, and run obliquely and winding, but not above half a yard deep below the surface. They end in a large space or nest, the storehouse. There is usually only one entrance. The sands and rubbish which surround modern Alexandria are much frequented by jerboas. They live there in troops. They are exceedingly shy and restless; any strange object, or the slightest noise, makes them retire to their holes with the utmost precipitation. The Arabs catch them alive by stopping up the outlets to the different galleries belonging to a colony, with the exception of one, which is netted, through which they force them to issue from the ground. They can walk on their hind legs; and on the approach of any danger they instantly take to flight, in leaps four or five feet high, which they repeat with so much swiftness, that a man mounted on a good horse can scarcely overtake them. They do not proceed in a straight line, but run first to one side and then to the other, till they find either their own burrow or some neighbouring one. When surprised, they will sometimes go on all-fours; but they soon recover their attitude of standing on their hind legs. When undisturbed, they use the former posture, then rise erect, listen, and hop about like crows. In digging or eating, they drop on their fore legs; but, in the latter process, they often sit upright like a squirrel. The Arabs of Tripoli were accustomed to teach their greyhounds to hunt the antelope by first instructing them to catch jerboas. So agile, however, are these little animals, that Bruce often saw, in a large courtyard or inclosure, the greyhound employed for a quarter of an hour before he could kill his diminutive victim.



THE JERBOA (*Dipus sagitta*).

Alactaga tetradactyla is found in the Libyan desert; Platycercomys platyurus in Central Asia.

The Jumping Hare of South Africa (*Pedetes caffer*) is a burrowing animal, making its holes in the soft, sandy ground, which it digs up with its fore paws, spurting it backwards with its hind feet, just as the rabbit does. In these burrows it sojourns during the day, secure from the attacks of the various carnivorous animals which infest the precincts of its retreat. Night is the season of activity; it steals forth at the close of daylight to feed; and, in some districts where it abounds, the depredations which it commits in the fields of grain are very serious.

It proceeds in the same manner as the jerboa, by a series of bounds; and, when the animal is pursued, each bound it makes clears a space of fifteen or twenty feet. It eats sitting nearly upright, and uses its fore feet in the manner of a squirrel, to convey the food to its mouth. It also sleeps in the same attitude, excepting that the head is bent down between the hind limbs, while the fore paws cover the eyes and ears. These hares prefer living in rocky and mountainous abodes. In some instances they colonise a considerable extent of ground, making it a complete warren.

The American Jerboa (*Jaculus hudsonianus*) occurs in North America from Nova Scotia to Pennsylvania. It is a small animal, about ten inches in length, of which the tail forms more than one-half. It is of a red-brown colour, a darker brown on the back and the sides, and below white.

THE JUMPING HARE (*Pedetes caffer*).

FAMILY LVI.—THE DORMICE (*Myoxidæ*).

The Dormice we may regard as forming but a single genus (*Myoxus*), though Professor Carus enumerates five. These little animals are found over all Northern Europe and Asia, and extend in Africa as far south as the Cape. They live in trees, and feed chiefly on nuts and insects, but also eat small birds and their eggs. They look like squirrels; and we may mention in passing that they seem to be unique among the Rodents in having no cœcum.

The Common Dormouse (*Myoxus* (*Muscardinus*) *avellanarius*) is found throughout Europe. The favourite resorts of the dormouse are dense thickets, low woods and coppices of hazel, bushy dells, and tangled hedge-rows. It creeps about the branches with a quick but gliding sort of movement, and with remarkable facility. It leaps nimbly, and makes its way so quickly through intertangled brushwood, that it cannot be easily captured. The dormouse appears to be, in some degree, gregarious, or at least to colonise favourite spots, for ten or a dozen of their nests have been seen at no great distance apart in the shrubs of a thicket. These nests, made of leaves and grass, are of a rounded form, about six inches in diameter, with the aperture at the top. In these the young are brought forth and reared. The number of the young is about four; they are born blind; in a few days, however, their eyes are opened, and in a short time they are able to provide for themselves. Corn, haws, hazel-nuts, and fallen acorns constitute the food of the dormouse. It eats sitting up like a squirrel, holding the food between its paws; and often it hangs suspended by its hinder feet, in which position it feeds as easily as in its ordinary attitude. The dormouse hibernates, and hoards up a store of provisions in holes, and the crevices about the roots of trees, to which it has recourse in winter, as its torpidity is not without interruption. A mid-day gleam of sunshine rouses it up in its snug retreat, and invites it forth, when it takes a little food. As the temperature diminishes it betakes itself to its dormitory, and rolling itself up into a ball, sinks into a profound slumber. It this state it may be handled without being roused from its trance. When roughly handled, however, a slight contraction has been observed, as if the animal were endeavouring to draw itself more closely together. If held in a warm hand for a short time, or put into a warm room, or near the fire, it will gradually awake, but when the cause of disturbance is removed it returns again to sleep. But, as in the case of the bat, this sudden revival, if often repeated, injures the dormouse, and produces death.

The Greater Dormouse (*M.* (*Eliomys*) *nitela*) is found throughout all the temperate parts of the European continent, extending into Russia in Asia. It comes as far north as Prussia. As gardens and orchards are its favourite abodes, it makes sad havoc among wall-fruits, attacking peaches, apricots, and pears especially, with great avidity. Its winter store, however, consists of nuts, peas, beans, and the like, which are collected in great abundance, and stowed away in some convenient recess, where eight or ten dormice assemble to pass the colder season in sleep. The summer nest, in which it rears its young, is built in the holes of walls or the chinks of aged trees. The young are four or five in number. The colour of these animals is reddish-grey; beneath it is white; a black patch surrounds the eye, and spreads behind the ear. The tail is covered with short black hair, except at the end, which is tufted with white. The length of the head and body is four inches and a half, of the tail four inches.

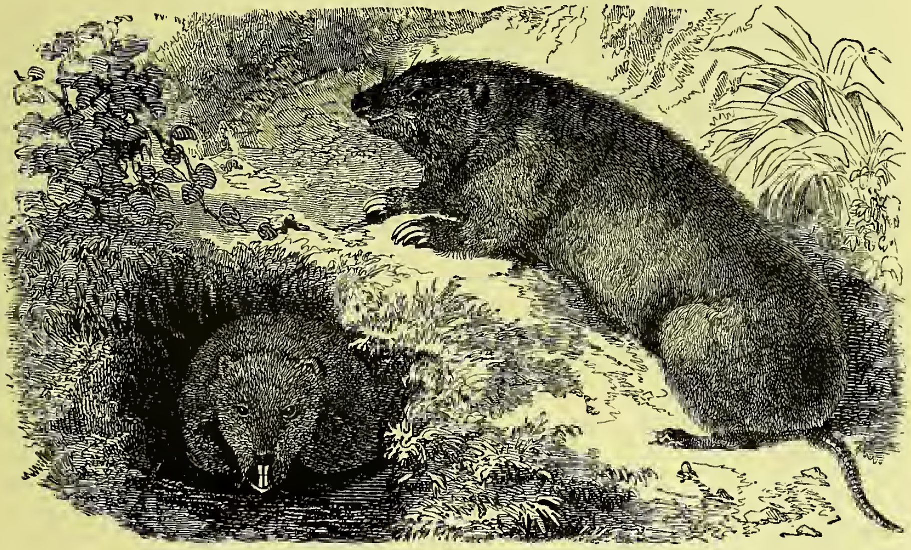
THE GREAT DORMOUSE (*Myoxus nitela*).

Myoxus glis is found in the middle and south of Europe, and was apparently the Glis of the ancients, who highly prized it as a dainty article of food, and fattened it in separate hutches.

The Cape Dormouse (*M.* (*Graphiurus*) *capensis*) is found at the Cape of Good Hope.

FAMILY LVII.—THE POUCHED RATS (*Saccomyidæ*).

The Pouched Rats are exclusively American, being found from Hudson's Bay to Honduras, though most of the species are found in central North America. Professor Lilljeborg makes two sub-families, which Professor Carus adopts. The first, that of Geomyini, contains but two genera, Geomys and Thomomys, the species of which have been lately (1875) carefully studied by Dr. E. Coues. The Canadian Pouched Rat (*Geomys bursarius*)—called Gaufre by the French, and Goffer by the Germans, whence the English term, Gopher—inhabits the Valley of the Mississippi and its tributaries in a broad sense. The pouches of this rat, so often strangely represented as everted, from copying Shaw's plate in the "Linnean Society Transactions" for 1800, are not pendulous bags hanging from the mouth and opening into it, but are wholly external, having no communication with it whatever; they are simply purse-shaped duplicatures of the loose skin of the side of the head and neck. "Notwithstanding their abundance," says Dr. Coues, "it is difficult to obtain specimens of this species. Their acute sense of smell gives them an early warning of the approach of danger, and they easily make their escape in the maze of tunnels. Should one even be driven into a blind passage, it would find little difficulty in baffling its pursuer, for it can burrow faster than a man can follow with a spade; and since it obliterates its track by throwing the soil behind, it leaves scarcely more trace of its passage in the loose sand than a fish swimming through the water. It is thought quite impossible to dig them out. Occasionally they are shot when they come to the surface to throw out sand; but they remain in sight only an instant, and the marksman, to be successful, must have his gun bearing upon the opening at which the animal is expected to appear, with finger on the trigger, and be ready to pull the moment the head is sighted. The senses of sight and hearing seem in them to be very dull. An object may be held within a short distance of their eyes without attracting their attention; but the moment one is touched he turns with a jump, snapping fiercely, much to the detriment of fingers that may be near. If two are confined in the same cage, the one does not seem aware of the presence of the other, unless they accidentally come in contact. Their eyes are small, dull, and without expression. Their sense of smell I judge to be very delicate, from the manner in which they approach the hills of potatoes. Their motions are surprisingly quick and energetic; their activity never ceasing from morning to night. They are very pugnacious, and a rough-and-tumble combat between two vigorous males would seem terrific, if their size could be magnified a few diameters in the eye of the spectator. Every muscle of their compact, elastic, stout bodies is brought into action, and they plunge and bite with wonderful ferocity. A battle is usually followed by the death of one or both. I have examined them after death, and found the whole anterior part of the body bruised almost to the consistency of paste, the bones of the legs crushed in four or five places. When two come together in the cage, their salutation is a plunge and a bite. I watched their burrowing with much interest. They dig by grubbing with the nose, and a rapid shovelling with the long, curved fore-paws, assisted by the pushing of the hind feet, which remove the dirt from beneath the body, and propel it back with great power a distance of eight or ten inches. When a small quantity of earth has accumulated in the rear of the miner, around he whirls, with a vigorous flirt of the tail, and joining fore-paws before his nose, he transmutes himself into a sort of wheelbarrow, pushing the dirt before him to a convenient distance, and repeating the act until the accumulation is removed, then resuming his mining. Any root or twig which blocks his way is quickly divided by his sharp chisel teeth. I have never seen one place sand in his cheek-pouches, though I have watched their burrowing hour after hour. It is, of course, impossible to observe them when at work underground, but I incline to believe that most of the refuse earth from the burrows is transported in the manner just described. The negroes told me that they had seen it appear at the mouth of its hole for an instant,



THE CANADIAN POUCHED RAT (*Geomys bursarius*).

and "spit out" the sand which it carried in its pouches, aiding the act by inserting the fore-paws *into* the pockets. I have never met any one who could tell *exactly* what it does at the instant he appeared, his motions being so quick that one cannot be quite sure; the general impression, however, is that they are unloading their cheek-pouches. This is not at all improbable, for we know that they carry their food in these receptacles, and it seems a very natural way for them to bring their refuse sand to the surface, since they often have to transport it a distance of several feet. Still, it is quite desirable to have other and more careful observations; for observers are apt to be deceived by their own eyes, especially in the light of pre-conceived opinions. The subterranean labyrinth constructed by this clever army of sappers and miners penetrates the pine-barrens and cultivated fields in every direction. An energetic individual, with a slight knowledge of engineering, would find little difficulty, I suspect, in making an underground journey through Florida from the Atlantic to the Gulf of Mexico. The direction of the burrows may easily be traced by the loose hillocks of white sand which are thrown up along the line, at intervals of three or four feet. These are the "dumps" made by the burrower in throwing out his refuse accumulations. Each consists of about a peck of loose sand, and, by the casual observer, might easily be mistaken for an ant-hill. No opening is visible, but by digging under the hill a hole is found—the mouth of the adit to the main tunnel, which may be three feet below the surface if made in cold weather, but perhaps not more than six inches if in summer. One of these mounds is thrown up in a very few moments. I have seen thirty raised in a single night on the line of one tunnel. This would represent nearly one hundred feet of tunnelling. I have seen one hundred and fifty in one continuous row raised in about two days. This would make between four and five hundred feet of burrow completed in that short time apparently by one little animal, an amount of work which may seem incredible to one who has not watched the restless movements of these animated ploughs, which are seemingly as well adapted for piercing the sand as birds are for cleaving the air. The burrows are about two and a half inches in diameter, barely large enough to admit a man's hand, and, as has been stated, are at various depths below the surface. They meander in all directions, except in straight lines, their builders being guided apparently only by their whims or their olfactories. They, no doubt, intersect each other at many points, and one tunnel serves as a passage for a community, though fierce battles must often ensue when two rival claimants meet in a common highway. The nests are large chambers, one or two feet from the main tunnel, with which they are connected by side-passages, which leave nearly at right angles. Here the miners lay up a supply of provisions, and the chambers are often found to contain a half-bushel of sweet potatoes, cut up into chunks as large as peach-stones, and of convenient size to be carried in the pockets. This animal is a liberal provider. In this region cellars are unknown, and sweet potatoes are stored in heaps at the surface, covered with straw and sand. They are cunning enough not to throw up sand-heaps in the vicinity of these potato-heaps, but remove the loose earth into their old tunnels. When they once get access to the "tater-hake," they quickly remove its contents, and the owner wakes up some morning to find his *cache* a hollow pretence. In these side-chambers they rear their young, building a nest of grass, pine-needles, and live-oak leaves. I found them breeding in April."

The other species met with are—G. tuza, found in Georgia, Florida, and Alabama; G. castanops, Texas and New Mexico; G. mexicanus, Mexico; G. hispidus, Mexico, Costa Rica, Guatemala; G. heterodus, Central America.

Of the genus Thomomys, we agree with Dr. Coues in regarding the three following species—Th. bulbivorous, Th. talpoides, and Th. umbrina—as well-marked geographical races of one species, not yet completely differentiated. They are to be met with in the Pacific Coast region.

The second sub-family, Saccomymi, contains Dipodomys ordii from Mexico, and several other species, ranging as far north as the Columbia River; Perognatus penicillatus, from California; and another species ranging as far south as Mexico.

FAMILY LVIII.—THE BEAVERS (*Castoridæ*).

There are but two species, placed in a single genus, belonging to this family. They are distinguished among the Rodents by having the hinder feet webbed. The European

Beaver (*Castor fiber*) appears to be confined to the temperate regions of Europe and Asia. It is still found, though but very rarely, in the great rivers of Central Europe, such as the Danube, Rhine, and Rhone; is rather rare in Russia, though it is apparently very numerous in Siberia, Tartary, and the Caucasus, and it extends as far as to the River Amoor.

The American Beaver (*C. canadensis*) ranges over the whole of North America, from Labrador to North Mexico.

BEAVERS (*Castor canadensis*).

FAMILY LIX.—THE SQUIRRELS (*Sciuridæ*).

This family, according to Professor Lilljeborg, includes not only the Squirrels, but the Marmots, Prairie Dogs, and Anomalures, which latter are placed, on account of their structure, in a sub-family by themselves. Nearly 200 species are known, and many of them are of great interest. To the first genus, Sciurus, nearly half the species of the family belong; it comprises the True Squirrels, and has been divided into many sub-genera. They are to be found in the temperate and tropical regions of the world, being absent only from the West Indian Islands, Madagascar, and Australia.

The Common Squirrel (*Sciurus vulgaris*) is common over all Europe in suitable localities. It is the only species of this extensive genus found in Britain, and is one of the most lively and beautiful of our indigenous quadrupeds. The squirrel is generally distributed in the wooded parts of our country; but in many districts, especially in Scotland, it is of rare occurrence. To the south of the Frith of Forth and the Clyde, it is not uncommon in plantations and parks. In the extensive tract lying east of the Grampians, and in some of the valleys of those mountains, it is not less frequent; but in the northern districts it appears to be unknown. The fur in autumn is rather long, dense, and soft; the ears fringed at the end with longish hairs; the tail bushy. The general colour of the upper parts is brownish-red, minutely dotted with yellowish-grey, the hairs being marked with brown, and whitish; the tail of a darker brown, with a very small portion of the tip whitish; the lower parts pure white; the feet and a band along the side light red; the bristles about the mouth dark brown. The length of the squirrel to the end of the tail is usually nine inches. The female is smaller than the male, and generally of a lighter colour. The agility of squirrels is, indeed, surprising. The rapidity with which they run up or down a tree, head foremost, going out even on slender twigs—the leaps they will take from one to another, or from bough to bough—and the skill with which they dodge entirely out of sight, when pursued, alike baffle description. It is a very difficult thing to shoot a squirrel in motion. They have been seen, when hard pressed, and when the distance to the next tree has surpassed their most extravagant leaps, to throw themselves off, spreading abroad their limbs, so as to make their body as parachute-like as possible, to break the fall; and, on reaching the ground without harm, bound along for the few intervening paces, and ascend the tree with a celerity almost too quick for the eye to follow. The squirrel, when in motion, always keeps its tail depressed. It feeds on nuts, beech-mast, acorns, buds, and the bark of young branches, generally, while eating, sitting on its haunches, with its tail elevated, holding the food between its paws, and dexterously unshelling the kernel, from which it even removes the outer pellicle before munching it. In autumn it lays up a store of provisions for winter, but usually in an irregular manner, depositing nuts in different places in the ground and in the holes of trees. When the cold weather commences, it becomes less active, and often dozes for days in its retreat, but it does not become absolutely torpid; and it has been seen abroad in the midst of a most severe snow-storm. If the weather be comparatively mild, it exhibits its usual activity, feeding on bark and twigs. The squirrel does not reside entirely on trees, but frequently takes to the ground, where it moves with nearly equal agility, leaping like a rabbit. The female produces three or four young, about Midsummer, which are

THE SQUIRREL (*Sciurus vulgaris*).

deposited in a nest formed of moss, fibrous roots, grass, and leaves, curiously interwoven, and placed in a hole, or in the fork between two large branches.

The Flat-tailed Flying Squirrels belong to the genus Sciuropterus. The skin of the sides is very much extended between the fore and hind legs, so as, to a certain extent, sustain the animal in the air when taking long leaps. The only European species is the Flying Squirrel (*S. volans*), which inhabits the forests of Lithuania, Livonia, Lapland, and Finland, being very common in Siberia. S. volucella is found in North America; and other species are met with in North China and Japan, through India and Ceylon to Java.

The Round-tailed Flying Squirrels form the genus Pteromys. P. petaurista occurs in Southern India, and all the species extend more to the tropics than those of the preceding genus, being oftenest met with in the woods of India.

The Ground Squirrels (*Tamias*) are almost all North American, but one is the European Ground Squirrel (*T. pallasii*), being found not only in Siberia, but extending into that corner of Europe which lies between the Dwina and the Ural Mountains. These squirrels dig their burrows in woody places, in small hummocks of earth, or near the roots of trees; but, never, like the common squirrels, do they make their nests in the trunk or branches, although, when scared from their holes, they climb with facility, and make their way from branch to branch with great speed.

THE FLYING SQUIRREL (*Sciuropterus volans*).

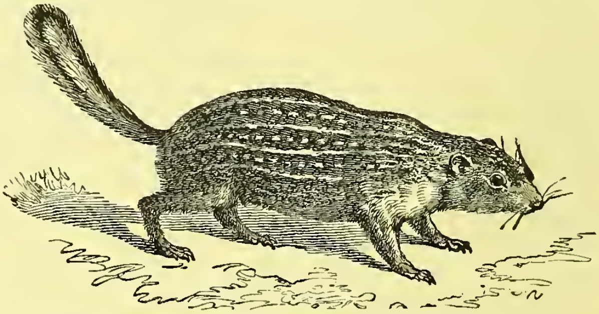
Another species, the Missouri Striped Squirrel (*T. quadrivittatus*), is found from the Upper Missouri to the Rocky Mountains, and west to the Cascade Range, along the Rocky Mountains. It is found as far south as Fort Stanton, New Mexico. It is an exceedingly active little animal, and very industrious in storing up provisions, being generally observed with its pouches full of the seeds of leguminous plants, bents, and grasses. It is most common in dry, sandy spots, where there is much underwood, and is often seen in the summer time sporting among the branches of willows and low bushes. It is a lively, restless animal, troublesome to the hunter, and often provokes him to destroy it by the angry, chirruping noise it makes at his approach, which is a signal of alarm to the other inhabitants of the forest.

During the winter it resides in a burrow with several openings, made at the root of a tree, and is never seen on the surface of the snow at that season. When the snow disappears, many small collections of hazel-nut shells, from which the kernel has been extracted by a minute hole gnawed in the side, are to be seen on the ground near its abode. Mr. Say states its nest to be composed of an extraordinary quantity of the burrs of a species of xanthium, portions of the upright cactus, small branches of pine-trees, and other vegetable productions—in some instances, sufficient to fill a cart. On the banks of the Saskatchewan, the mouths of the burrows are not so protected. The Four-Banded Squirrel is named *Le Suisse* by the French Canadians, an appellation which, according to Father Theodat, arose from the skins being rayed with black, white, red, and grey, like the breeches of the Switzers who form the Pope's guard.

THE POUCHED MARMOT (*Spermophilus citilles*).

The Pouched Marmots (*Spermophilus*) are to be met with in the north-western portions of North America, extending to Mexico, and in Northern Asia, through South Russia to the Amoor and Kamtchatka, but descending to the great plains of Tartary and Mongolia. One species, Spermophilus citillus, wanders west as far as Poland and Austria, and is said to be found in the Crimea. In Silesia it is common in sandy places. In general it leads a solitary life, or is found in pairs. It burrows in the earth on the sloping sides of mountains, lays up for the winter a store of corn and other grain, which it conveys in its cheek-pouches, and passes part of that season in a semi-torpid state. Baird enumerates fourteen American species.

Parry's Marmot (*S. parryi*) abounds on the shores and islands of the Arctic Seas, and is to be met with on the Asiatic side of Behring's Strait. It is found generally in stony districts, but seems to delight chiefly in sandy hillocks amongst rocks, where burrows, inhabited by different individuals, may be often observed crowded together. One of the society is generally noticed sitting erect on the summit of a hillock, whilst the others are feeding in the neighbourhood. On the approach of danger he gives the alarm, and they instantly hurry to their holes, remaining, however, chattering at the entrance, until the advance of the enemy obliges them to retire to the bottom. When their retreat is cut off, they become greatly terrified, and, seeking shelter in the first crevice, they not unfrequently succeed in hiding the head and fore part of the body, whilst the projecting tail is, as is usual with them under the influence of terror, spread out flat on the rock. Their cry in this time of distress strongly resembles the loud alarm of the Hudson's Bay Squirrel, and has some resemblance to the sound produced in former days by a watchman's rattle. The name given to the animal by the Esquimaux is an attempt to express this sound.



THE THIRTEEN STRIPED SPERMOPHILE (*S. tredecimlineatus*).

These creatures are easily tamed, and very cleanly and playful when domesticated. They never come abroad during the winter. Their food appears to be entirely vegetable, their pouches being generally filled, according to the season, with tender shoots of herbaceous plants, berries of the Alpine arbutus, and of other trailing shrubs, or the seeds of grasses and leguminous plants. They produce about seven young at a time. These little animals form a transition between the squirrels and the marmots.

The Marmots (*Arctomys*) have no buccal pouches, and are found living at high elevations in North America, Central Europe, across to Lake Baikel and Kamtchatka, and on the Himalayas. The Marmot (*Arctomys marmota*) lives near the snow-line or mane of the high mountains of Europe, in the Bernese Alps, in Savoy, and Piedmont. It is not known in Spain. Its burrow underground is contrived with great art, and consists of an oval cavity or general receptacle, large enough to contain several animals, living, as they do, in little societies. It has generally three chambers, in the shape of a Y, with two entrances. On the approach of winter, the marmot betakes itself to its burrow, where it makes a warm bed of dried grass on which to repose during the cold season. Unlike the squirrel, it provides no winter stores; but, stopping up the entrances of their burrows with earth, doze away the inclement months, till the warm suns and showers of April arouse them from their torpidity to partake of the renewed vegetation. From five to twelve animals are said to lodge in one burrow. They lift their food to their mouths with the fore feet, eat it sitting, and will walk on their hind feet. They are playful creatures, but when angry, or before a storm, can pierce the ear with their shrill whistle.

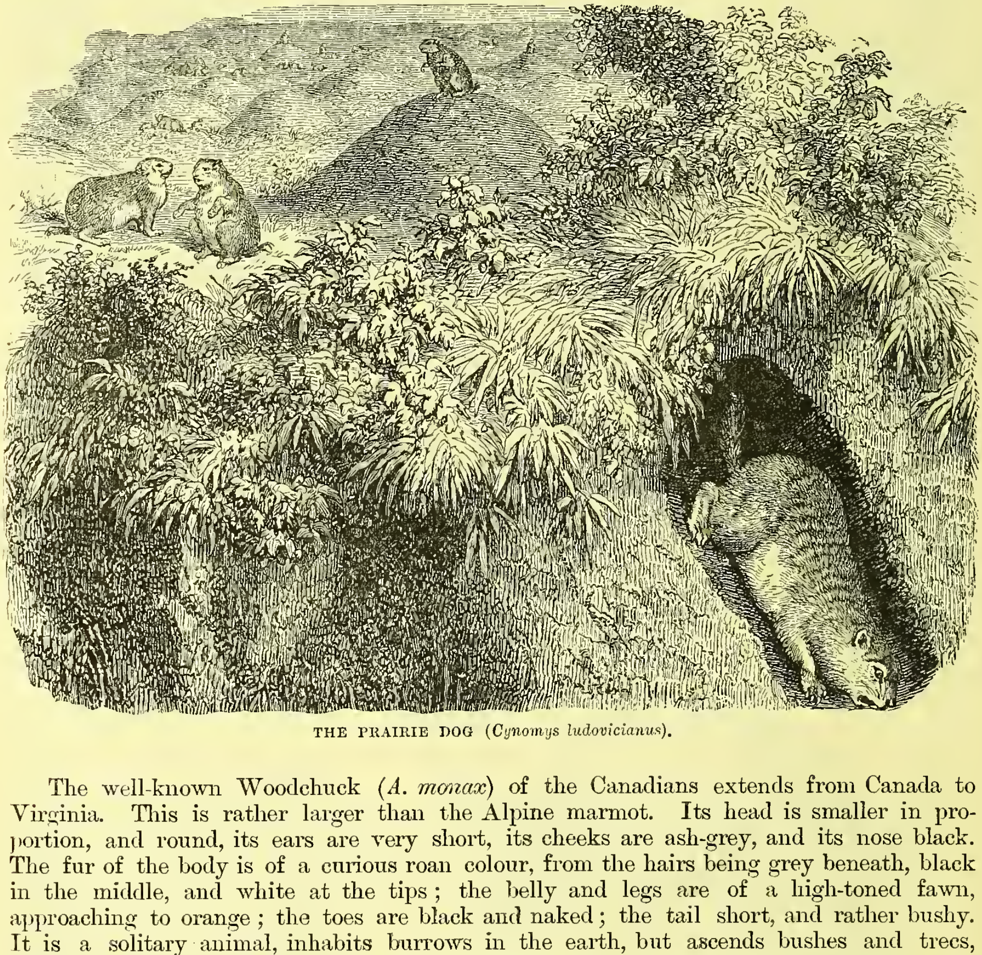
When taken young, the marmot may easily be tamed, and will eat any kind of vegetables, which, together with insects and roots, are their natural food. Milk pleases these animals greatly, and they lap it with sounds of pleasure. They become fat, and are sometimes eaten. The number of young at a birth is generally three or four. Marmots are often taken by Savoyards and other itinerants to be shown in begging, like white mice, monkeys, and other creatures.

The Bobak (*A. bobac*) inhabits the southern parts of Russia, also those ot the regions through which flow the Dnieper and its tributary streams, whence it ranges through a great part of Northern Asia. It gives preference to hills of moderate elevation, and chooses a dry locality for its abode. The general colour of the fur is a greyish-yellow, mingled with brown; the latter forming transverse undulations on the upper parts. The under parts are of a rust-brown. The length of the head and body is sixteen or seventeen inches, of the tail, six inches. The burrows which the bobaks form in the ground are constructed obliquely, and are of the depth of two, three, or four yards. They comprise a number of galleries, which have from the surface one common entrance, each gallery terminating in a nest for some of its inhabitants. Sometimes, however, the burrows consist of only one passage. Though these burrows are found in the greatest number where the earth is the lightest, yet they are frequent even in the strata of the mountains. In hard and rocky places from twenty to forty bobaks unite to facilitate the work; and they live in society, each with its nest at the end of its respective gallery. They accumulate in their retreat a quantity of dried herbage for early spring consumption, as well as for the sake of warmth, before the severity of the season commences.

THE BOBAK (*Arctomys bobac*).

During the middle or sunny part of the day they sport about the entrance of their burrows, but seldom go far from them. At the sight of man they retire at a slow pace, and sit upright near the entrance, giving a frequent whistle, and listening to the approach. In places where they live in large families, they always place a sentinel to give notice of any danger during the time when the rest are employed in feeding. The bobaks are mild, gentle, timid creatures. They feed only on vegetables, which they search for in the morning, and about the middle of the day. They sit on their hams when they eat, and carry their food to their mouth with their fore paws; and in this posture they are said to defend themselves when attacked. When irritated, or when any one attempts to lay hold of them, they bite desperately, and utter a shrill cry. From six to eight young ones are produced early in the spring.

In the summer the bobaks eat voraciously, but remain torpid all the winter, except when kept in very warm places; even then they eat but little, and will, if possible, escape to some comfortable spot in which to pass this dreary season; but they will return to their master in the spring. They soon become tame, even when taken of full age; the young ones are familiar from the moment they are caught. The flesh of the bobaks is eatable, and, except that it is rather rank, resembles that of the hare. The skins are employed by the Russians for clothing, and the fat is used in the dressing of leather and furs.



THE PRAIRIE DOG (*Cynomys ludovicianus*).

The well-known Woodchuck (*A. monax*) of the Canadians extends from Canada to Virginia. This is rather larger than the Alpine marmot. Its head is smaller in proportion, and round, its ears are very short, its cheeks are ash-grey, and its nose black. The fur of the body is of a curious roan colour, from the hairs being grey beneath, black in the middle, and white at the tips; the belly and legs are of a high-toned fawn, approaching to orange; the toes are black and naked; the tail short, and rather bushy. It is a solitary animal, inhabits burrows in the earth, but ascends bushes and trees, probably in search of buds and other vegetable productions, on which it feeds. A. tibetanus and A. himalayanus are described by Mr. Hodgson as living respectively on the Tibet plains and near the snow-line on the slopes of the Himalayas. These, possibly, are but geographical varieties of the bobak.

The Prairie Dog of North America (*Cynomys ludovicianus*) inhabits the Upper Missouri—west towards the Rocky Mountains, and south to the Red River; and the second species, C. gunnisonii, occurs in the Rocky Mountains.

SUB-FAMILY 2.—THE ANOMALURUS (*Anomalurini*).

This is an aberrant group of squirrels. They are provided with a hairy skin, which is expanded between the arm-bone and the hind feet, produced from the soles of the feet, along the thighs, and joining the tail at its base with the thighs. The tail is longer than half the body; it is clothed with rigid hair, which forms a more or less prolonged tuft at the end. Below, at the base, it is covered with a double row of horny scales, which are imbricate and alternate. Anatomically they differ from all the squirrel sub-family, in the absence of the post-orbital process of the frontal bone, in the large infra-orbital foramen, and in the large number of ribs—fifteen. A cartilaginous, sickle-shaped ligament passes off from the ulnar process, and supports the membrane of flight. The only genus in the sub-family is that of Anomalurus, established in 1842 by Mr. Waterhouse for A. fraseri, in honour of Mr. Frazer, the naturalist to the Niger Expedition. It was found on Fernando Po. Mr. Frazer observed that it used the tail scales to support itself when resting on the trees, which it ascends with great agility. It can also dart from the top of a lofty tree to another at a considerable distance. Descending at an angle, it aimed with great nicety at the trunk of the tree on which it intended to alight, and settling near the base, it would again ascend, to travel to a third tree in the same manner. Occasionally, when high up on the trunk, it would rest itself, making use of the singular apparatus of scales on the under side of the tail. The unarmed portion of the tail was then turned upwards and backwards. A second species, A. pelii, occurring in Ashantee, and a third species, A. beecroftii, from Fernando Po, is beautifully figured on Plate 32, Mammalia, of the "Proceedings of the Zoological Society of London." In A. fulgens (described by Dr. Gray, from the Gaboon), the scales on the under side tail appear to be almost spine-like.

THE ANOMALURE *(A. fraseri).*

FAMILY LX.—HAPLODONTIDÆ.

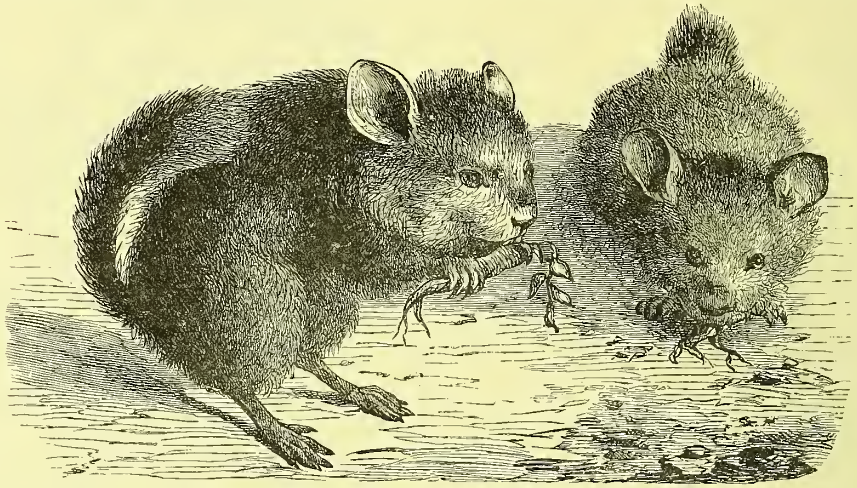
This family has been proposed by Professor Lilljeborg for a curious rat-like animal (*Haplodontia leporina*), with apparent affinities to both the beavers and marmots, found in North America at Paget's Sound, which is described by Richardson as being found near the River Columbia, to the west of North America.

FAMILY LXI.—THE CHINCHILLAS (*Chinchillidæ*).

The few animals composing this family are found in the Alpine regions of the Andes, and over the Pampas. The molar teeth are composed of narrow transverse parallel lamellæ, the hind feet are longer than the fore feet, and the tail is furnished with long hair. The Chinchilla (*Chinchilla lanigera*), and an allied species with a shorter tail (*C. brevicaudata*), are found in the Andes of Chili and Peru, at from 8,000 to 12,000 feet of an elevation. The fore feet have five and the hind feet four toes, and the ears are rounded.

Shortly after the conquest and occupation of South America, the soft and delicate fur of the chinchilla was known as an article of commerce. The length of the body is about nine inches, and that of the tail nearly five. The fur is long, thick, close, woolly, somewhat crisped, and entangled together, greyish wash-coloured above and paler beneath. The form of the head resembles that of the rabbit; the eyes are full, large, and black, and the ears broad, naked, rounded at the tips, and nearly as long as the head. The whiskers are plentiful and very long, the longest being twice the length of the head, some of them black, and others white. The tail is about half the length of the body, of equal thickness throughout, and covered with long bushy hairs; it is usually kept turned upwards towards the back, but not reverted, as in the squirrels.

According to Mr. Bennett, the chinchilla usually sits on its haunches, and is even able to raise itself up and stand upon its hinder feet. It feeds in a sitting posture, grasping its food and conveying it to its mouth by means of its fore paws. In its temper it is generally mild and tractable; but it will not always suffer itself to be handled without resistance, and sometimes bites the hand that attempts to fondle it, when not in a humour to be played with.



THE CHINCHILLA (*Chinchilla lanigera*).

The Alpine Viscacha (*Lagidium cuvierii*) inhabits the lofty Andes of Chili, Bolivia, and Peru, being found at heights of nearly 16,000 feet. It, and the other two species of this genus, have four toes on both hind and fore feet, and their ears are long and rabbit-like. Their fur is beautifully soft, downy, and of considerable length. The general tone of colour is a mottled, greyish-ash. On the sides of the neck and body, where the tips of the fur merge more into yellowish-brown than on the back, and where they are also of greater length, as well as on the haunches beneath, the latter tinge appears rather predominant. There is little of the dusky colour visible on the under surface. The hairs of the tail below are extremely short, closely depressed, and of a brownish-black; on its sides they are of two kinds, black and white; and this is also the case with the very long, rigid, and erectile hairs, which form a crest along its upper surface. The very long, bristly hairs which project in a tuft at the tip are wholly black.

Their native country is an extensive plain occupying the very top of the Andes, and stretching from east to west more than 250 miles, whilst its width gradually increases to 150 miles, at the places where the mountain masses descend to the Pacific. The elevation of this plain has not been determined, but it probably rises 13,000 feet above the sea level.

L. pallipes extends as far north as Ecuador.

The Viscacha of the Pampas (*Lagostomus trichodactylus*) lives in the pampas of South America. While the fore feet are tetra, the hind feet are tridactylous. The whiskers are wonderfully long and strong. Mr. W. H. Hudson has given a most graphic account of their habits, from which we give the following long extract:—

"The viscachas in the pampas of Buenos Ayres live in societies, usually numbering twenty or thirty members. The village (called here 'Viscachera') is composed of a dozen or fifteen burrows or mouths: for one entrance often serves for two or more distinct holes. Often, where the ground is soft, there are twenty or thirty or more burrows in an old viscachera; but on stony, or 'tosca' soil, even an old one may have no more than four or five burrows. They are deep, wide-mouthed holes, placed very close together, the entire village covering an area of from 100 to 200 square feet of ground. The burrows vary greatly in extent; and usually in a viscachera there are several at a distance of from four to six feet from the surface. Some of these burrows or galleries communicate with those of other burrows. A vast amount of loose earth is thus brought up, and forms a very irregular mound, fifteen to thirty inches above the surrounding level. It will afford some conception of the numbers of these viscacheras on the settled pampas when I say that, in some directions, a person might ride 500 miles, and never advance half a mile without seeing one or more of them. In districts where, as far as the eye can see, the plains are as level and smooth as a bowling-green, especially in winter, when the grass is close-cropped, and where the rough giant-thistle has not sprung up, these mounds appear like brown or dark spots on a green surface. They are the only irregularities that occur to catch the eye, and consequently form an important feature in the scenery. In some places they are so near together that a person on horseback might count a hundred of them from one point of view. The sites of which the viscacha invariably makes choice to work on, as well as his manner of burrowing, adapt him peculiarly to live and thrive on the open pampas. The first thing that strikes the observer when viewing the viscachera closely is the enormous size of the entrance of the burrows, or, at least, of several of the centre ones in the mound, for there are usually several smaller outside burrows. The pit-like opening to some of these principal burrows is often four to six feet across the mouth, and sometimes deep enough for a tall man to stand up waist-deep in. How these large entrances can be made on a level surface may be seen when the first burrow or burrows of an incipient viscachera are formed. It is not possible to tell what induces a viscacha to be the founder of a new community, for they increase very slowly, and, furthermore, are extremely fond of each other's society; and it is invariably one individual that leaves his native burrows to make a new and independent one. If it were to have better pasture at hand, then he would certainly remove to a considerable distance; but he merely goes from fifteen to fifty or sixty yards off to begin his work. Thus it is that in desert places, where these animals are rare, a solitary viscachera is never seen; but there are always several close together, though there may be no others on the surrounding plain for leagues. When the viscacha has made his habitation, it is but a single burrow, with only himself for an inhabitant, perhaps, for many months. Sooner or later, however, others join him, and these will be the parents of innumerable generations; for they construct no temporary lodging-place, as do the armadillos and other species, but their posterity continues in the quiet possession of the habitations bequeathed to it; how long, it is impossible to say. Old men, who have lived all their lives in one district, remember that many of the viscacheras around them existed when they were children. It is invariably a male that begins a new village, and makes his burrow in the following manner, though he does not always observe the same method. He works very straight into the earth, digging a hole twelve or fourteen inches wide, but not so deep, at an angle of about 25° with the surface. But after he has progressed inwards a few feet, the viscacha is no longer satisfied with merely scattering away the loose earth he fetches up, but cleans it away so far in a straight line from the entrance, and scratches so much on this line (apparently to make the slope gentler), that he soon forms a trench a foot or more in depth, and often three or four feet in length. Its use is, as I have inferred, to facilitate the conveying of the loose earth as far as possible from the entrance of the burrow. But after a while, the animal is unwilling that it should accumulate even at the end of this long passage; he therefore proceeds to form two additional trenches, that form an acute, sometimes a right angle, converging into the first, so that when the whole is completed it takes the form of a capital Y. In winter the viscachas seldom leave their burrows till dark, but in summer come out before sunset; and the viscachera is then a truly interesting spectacle. Usually one of the old males first appears, and sits on some prominent place on the mound, apparently in no haste to begin his evening meal. When approached from the front he stirs not, but eyes the intruder with a bold indifferent stare. If the person passes to one side, he deigns not to turn his head. Other viscachas soon begin to appear, each one quietly taking up his station at his burrow's mouth, the females, known by their greatly inferior size and lighter grey colour, sitting upright on their haunches, as if to command a better view, and indicating by divers sounds and gestures that fear and curiosity struggles in them for mastery; for they are always wilder and sprightlier in their motions than the males. With eyes fixed on the intruder, at intervals they dodge the head, emitting at the same time an internal note with great vehemence, and suddenly, as the danger comes nearer, they plunge simultaneously, with a startled cry, into their burrows. But in some curiosity is the strongest emotion ; for in spite of their fellows' contagious example, and already half down the entrance, again they start up to scrutinise the stranger, and will then often permit him to walk within five or six paces of them. The viscacha is about two years growing. A full-sized male measures, to the root of the tail, twenty-two inches, and weighs from fourteen to fifteen pounds. Probably it is a long-lived, and certainly it is a very hardy animal. Where it has any green substance to eat, it never drinks water ; but after a long summer drought, when for months they have subsisted on bits of dried thistle-stalks and old withered grass, if a shower falls, they will come forth from their burrows, even at noonday, and drink eagerly from the pools. It has been erroneously stated that they subsist on roots. Their food is grass and seeds ; but they may also sometimes eat roots, as the ground is occasionally seen scratched up about the burrows. In March, when the stalks of the perennial cardoon, or Castile thistle (*Echinops ritro*), are dry, the viscachas fell them by gnawing about their roots, and afterwards tear to pieces the great dry flower-heads to get the seeds embedded deeply in them, of which they seem very fond. Large patches of thistle are often found served thus, the ground about them literally white with the silvery bristles they have scattered. This cutting down tall plants to get the seeds at the top seems very like an act of pure intelligence ; but the fact is the viscachas cut down every tall plant they can. I have seen whole acres of maize destroyed by them, yet the plants cut down were left untouched. If posts be put into the ground within range of their nightly rambles, they will gnaw till they have felled them, unless of a wood hard enough to resist their chisel-like incisors. The strongest instinct of this animal is to clear the ground thoroughly about its burrows, and it is this destructive habit that makes it necessary for cultivators of the soil to destroy all the viscachas in or near their fields. On the uninhabited pampas, where the long grasses grow, I have often admired the viscachera, for it is there the centre of a clean space, often of half an acre in extent, on which there is an even, close-shaven turf ; this clearing is surrounded by the usual rough growth of herbs and giant grasses. In such situations this habit of clearing the ground is eminently advantageous to them, as it affords them a comparatively safe spot to feed and disport themselves on, and over which they can fly to their burrows, without meeting any obstruction, on the slightest alarm. Of course, the instinct continues to operate where it is no longer of any advantage. In summer, when the thistles are green, even when growing near the burrows, and the giant thistle (*Carduus mariana*) springs up most luxuriantly

THE VISCHACA (*Lagostomus trichodactylus*).

right on the mound, the viscachas will not touch them, either disliking the strong astringent sap or repelled by the thorns with which they are armed. As soon as they dry, and the thorns become brittle, they are levelled, and afterwards, when the animal begins to drag them about and cut them up, as his custom is, he accidentally discovers and feasts on the seed; for viscachas are fond of exercising their teeth on hard substances, such as sticks and bones, just as cats are of 'sharpening their claws' on trees. Another remarkable habit of the viscacha—that of dragging to and heaping about the mouth of his burrow every stalk he cuts down, and every portable object that by dint of great strength he can carry—has been mentioned by Azara, Darwin, and others. On the level plains it is a useful habit, for as the viscachas are continually deepening and widening their burrows, the earth thrown out soon covers up these materials, and so assists in raising the mound. On the Buenos Ayrean pampas numbers of viscacheras would annually be destroyed by water in the great sudden rainfalls were the mounds less high. The language of the viscacha is wonderful for its variety. When the male is feeding he frequently pauses to utter a succession of loud, percussive, and somewhat jarring cries; these he utters in a leisurely manner, and immediately after goes on feeding. Often he utters this cry in a low grunting tone. One of his commonest expressions sounds like the violent hawking of a man clearing his throat; at other times he bursts into piercing tones, that may be heard a mile off, beginning like the excited and quick-repeated squeals of a young pig, and growing longer, more attenuated, and quavering towards the end. After retiring alarmed into the burrows, he repeats at intervals a deep internal moan. All these, and many other indescribable guttural, sighing, shrill, and deep tones, are varied a thousand ways in strength and intonation, according to the age, sex, or emotions of the individual; and I doubt if there is in the world any other four-footed thing so loquacious, or with a dialect so extensive. I take great pleasure in going to some spot where they are abundant, and sitting quietly to listen to them, for they are holding a perpetual discussion all night long, which the presence of a human being will not interrupt. At night, when the viscachas are all out feeding in places where they are very abundant (and in some districts they literally swarm), any very loud or sudden sound, as the report of a gun or a clap of unexpected thunder, will produce a most extraordinary effect. No sooner has the report broken on the stillness of night than a perfect storm of cries bursts forth over the surrounding country. After eight or nine seconds there is in the sounds a momentary lull or pause, and then it breaks forth again, apparently louder than before. There is so much difference in the tones of different animals that the cries of individuals close at hand may be distinguished amidst the roar of blended voices coming from a distance. It sounds as if thousands and tens of thousands of them were striving to express every emotion at the highest pitch of their voices, so that the effect is indescribable, and fills a stranger with astonishment. Should a gun be fired off several times, their cries become less each time; and after the third or fourth time it produces no effect. They have a peculiar, sharp, sudden, 'far-darting' alarm-note when a dog is spied, that is repeated by all that hear it, and produces an instantaneous panic, sending every viscacha flying to his burrow."

FAMILY LXII.—SPALACOPODIDÆ.

Professor Lilljeborg sub-divides this family into three sub-families, the first two of which are by most regarded as equivalent to families, and the third is generally looked on as a section of the Porcupines. These are as follows:—

Sub-Family 1.—Octodontini.

In this sub-family we have a number of strange rat-like forms, nearly all of which occur in South America and the West Indian Islands. Habrocomus bennettii and H. cuvierii are both natives of Chili; Capromys pilorides and C. prehensilis inhabit the Island of Cuba. The intelligence of the former species, we learn from M. Desmarest, appears to be developed as fully as that of rats and squirrels, and much more so than that of rabbits and guinea-pigs. They have, indeed, a great share of curiosity. At night they are very wakeful, and the form of the pupils of the eyes indicates nocturnal habits. The sense of hearing does not appear so acute as that of rabbits and hares. Their nostrils are incessantly in motion, especially when they smell any new object. Their taste is sufficiently delicate to enable them to distinguish and reject vegetables which have been in contact with animal substances, to which they evince the greatest repugnance. They sleep close to each other, and agree together perfectly well. When apart, they call each other by a sharp cry, differing little from that of a rat. Their voice, when they express pleasure, is a low, soft kind of grunting. Their food consists of vegetables exclusively, such as cabbage, nuts, grapes, and apples. Their movements are slow, and they walk on the sole of the foot, just as we see the bear do. They leap occasionally, turning suddenly round from head to tail, like the field mouse. When they climb, which they do with the greatest ease, they use the base of the tail as a support, as they do in descending. In certain positions—on a stick, for example—the tail serves as a balance to preserve their equilibrium. They often raise themselves to a listening attitude, sitting erect, with the paws hanging down, like rabbits and hares. In eating, they employ sometimes only one, and at others both their fore paws; the former is the case when the substance they are holding is small enough to be held between the fingers and the tubercle at the base of the thumb.

Plagiodontia œdium is a native of St. Domingo. Spalacopus poeppigii is found in Chili, and S. fuscus on the east of the Andes. Octodon dijus and an allied species are described from Chili. Ctenomys brasiliensis is the tuco-tuco of the pampas, and C. magellanicus is found as far south as Terra del Fuego. Ctenodactylus massonii, a lemming-like rodent, of a yellowish-grey colour, has been described by Dr. J. E. Gray from Tripoli. Mr. Ogilby suggests that this is the Mus gundi of Rothman, who found it near Massufin, towards Mount Atlas. The inner toe of the hind foot is furnished with a horny comb and curved hairs concealing the small compressed claws. Mr. Yarrel says that with this comb-like instrument the little animals were observed to be continually dressing their soft light-grey fur; and the facility with which they managed to reach every part of each lateral half with the toe of the foot of that side, as well as the rapidity of the motion, was quite remarkable. When walking, they planted the whole length of the hinder foot on the ground, though they only placed the extremities of the toes of the front feet. The total length of the animal was eight inches, and of the tail one inch.

CTENOMYS BRASILIENSIS.

Pectinator spekei, described by Blyth from the Somali Land, may prove to be but a species of the previous genus. It is found living some 4,000 to 5,000 feet high on the Abyssinian Mountains, according to Blandford.

SUB-FAMILY 2.—ECHINOMYINI.

These spiny rats are mostly found in South America, but a few are natives of South Africa. Dactylomys typus and Cercomys cunicularis are natives of Brazil. Petromys typicus occurs in South, and Aulacodus swinderianus in South-west Africa.

The Coypu (*Myopotamus coypus*) is found on both the east and west of the Peruvian Andes. The skins of this animal were long known in trade under the name of the South American Otter, and were brought in hundreds of thousands each year to Europe. It is an animal of about two feet in length, with a tail of about a foot long, which is round and pilose. The toes of the hind feet are five in number, and, unlike the beaver, the fifth toe is free from the web that connects the other four together.

In the "Transactions of the Linnæan Society" for 1812, an account of it is given by the Rev. E. J. Burrow, which was the first description of the animal given in this country. He says: "The person who first possessed the animal in this country states that he bought it on board a ship from the Brazils. I had afterwards frequent opportunities of observing it, and of making my drawing while it was alive at Exeter 'Change. It died suddenly, and without any apparent cause, and is now in the collection of Mr. Bullock. When teased or disturbed, it uttered a weak cry, but was good-tempered, and not easily roused to resistance." The coypu resides habitually in burrows or holes, which it excavates along the banks of the larger rivers, and in them the female brings forth her young, from five to seven in number, towards which she manifests great attachment, taking them with her as soon as sufficiently grown to follow her in her rambles. The head is large, thick, and depressed on the top, the eyes being small, and placed so as to be above the water while the animal is swimming. The eyes approximate to each other. The ears are small and rounded; the whiskers long and wiry.

Carterodon sulcidens is remarkable as having first (1839) been described from skulls found by Lund in a cavern in Brazil, which were characterised by having the upper incisor teeth indented on the outer part by a longitudinal groove; but after some time the animal was discovered to be still living in Brazil, and was re-described in 1851 by Reinhardt.

Echinomys cayennensis is a native of Guiana and Brazil. The spines in the adult are mostly mixed with hair. There are several other species of this genus, of which E. spinosus from Brazil has been living in the London Zoological Gardens. Loncheres cristata is a large species with flattened spines, and a long tail covered with a few hairs. It is found in Guiana and Brazil, and the other species of the genus have nearly the same habitat.

SUB-FAMILY 3.—CERCOLABINI.

This contains the Tree Porcupines. All of them are found in America, where they are to be met with wherever there are great forests, with the exception of one large district—that of the Southern United States. They have the head short and somewhat truncated; the molar teeth have roots distinctly divided, and the jaws are without deep sockets. The soles of the feet are warty. They feed on young shoots, and the bark of trees, and on fruits.

The Brazilian Tree Porcupine (*Cercolabes prehensilis*) has, like all the species of this genus, a long prehensile tail, thinly haired towards the tip. Its muzzle is broad and short; the head convex in front; the spines rather short. The feet have only four toes. The length of this species is about two feet, exclusive of the tail, which is about eighteen inches. The nose is covered with brownish hair; the ears are nearly naked; the body is covered above with spines; the longest, on the lower part of the back, are about three inches in length; those on the sides and base of the limbs are the shortest; they are all sharp, and barred near their points and roots with white, with a brown band in the middle. The basal half of the tail is clad with short spines; the breast, under parts, and lower portions of the limbs with dark-brown bristles.

THE CANADIAN PORCUPINE (*Erethizon dorsatus*).

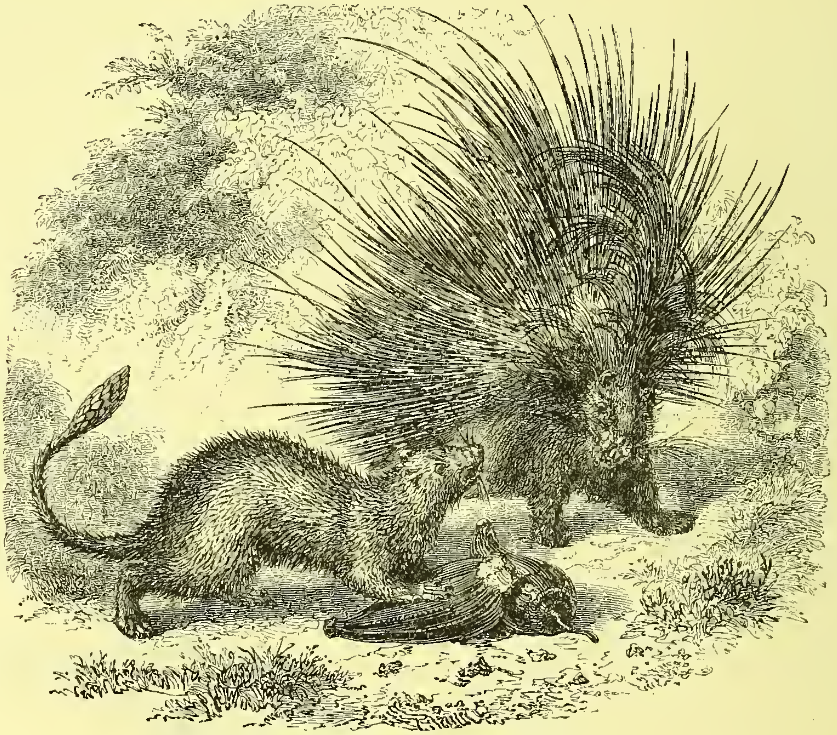
C. mexicanus is from Honduras; C. insidiosus is from Surinam; and there are seven or eight other species to be met with on the eastern side of the Andes, living in Mexico, Guatemala, and Paraguay. All of them live in trees, feed on fruits, are slow in their movements, and mostly rest by day.

The Canadian Porcupine (*Erethizon dorsatus*) is found throughout Canada as far south as Northern Pennsylvania. In the fur countries it is most numerous in sandy districts covered with pine trees, on the bark of which it delights to feed; it also eats the bark of the larch and spruce firs, and the buds of various kinds of willow; and in the more southern districts it feeds chiefly on other vegetable products, and is fond of sweet apples and young maize, which it eats in a sitting posture, holding the food with the fore-paws to its mouth. The Canadian porcupine is a sluggish animal. The Indians who used to go with packets from fort to fort often saw them in the trees, but not having occasion for them at the time, left them till their return; when, if their absence extended even beyond a week or ten days, they were sure to find the porcupines within a mile of the place where they had seen them before.

In walking, the tail is drawn along the snow, making a deep track, which is often the means of betraying the animal. Its haunts are, however, most readily discovered by the barked trees on which it has fed, which, if barked the same winter, are sure signs of their vicinity. They are usually found on the branches, and on approaching them, they make a crying noise like a child. The tree is then cut down, and the porcupine is killed by a blow on the nose.

E. epixanthus is a native of the Upper Missouri district and of the whole Pacific Coast. E. rufescens has been lately described by Dr. J. E. Gray, from Columbia. All the species have short tails, and the spines are nearly concealed among the long hairs.

Chætomys subspinosus is a native of North Brazil. The body and limbs are covered with sub-equal short and rather flexible spines. The tail is long and conical, and provided with rings of square scales and scattered bristles.



PORCUPINES (*Hystrix cristata* and *Atherura Africana*).

FAMILY LXIII.—THE PORCUPINES (*Hystricidæ*).

This family contains the Porcupines, which are exclusively met with in the Old World, and the Cavies and Agoutis, only met with in the New World. It thus naturally falls into two sub-families.

SUB-FAMILY 1.—HYSTRICINI.

The True Porcupines are met with in the South of Europe, over the whole of Africa, and in Southern Asia. The Common Porcupine (*Hystrix cristata*) is to be met with still in some parts of Spain, Italy, in the Apennines, and Greece. Though some think it has been introduced into Europe, and that its true habitat is North Africa, Dr. Sclater is inclined to think that the Indian H. leucura and South African H. africæ-australis may be but varieties of this species.

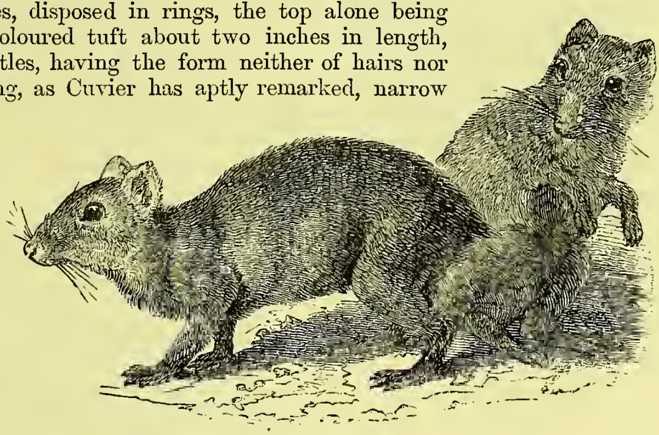
The spines of the porcupine are elegantly ringed with broad bands of black and white. It was long ago supposed that the porcupine could launch them as darts at any of his adversaries. Aristotle, Pliny, and Oppian state it as a fact, and it is adopted by Aldrovandus. It is gravely alluded to by Bosman, who, describing his voyage in Guinea, says, "When the porcupine is enraged, it springs with extreme rapidity (having its spine all arranged, which are often two palms in length) on man and beast, and it darts them with such force that they are capable of piercing a plank." This error, like many others, is not without a slight foundation. The porcupine, finding it necessary to act on the defensive, and with neither teeth nor talons for so doing, turns his back to the foe, buries his head between his fore limbs, erects his quills, and, shaking them violently, produces a rustling sound. Should the assailant advance to close quarters, the assailed pushes backwards against him, and that so suddenly, and with such energy, as to force the sharp points of the spines into the flesh and inflict a most painful wound. Now, the quills of the porcupine are but slightly attached to the skin; it therefore often happens that one or two, more loose than the rest, or about to be shed, are, when clashed together, thrown off; and also that, when thrust into any object, they are very likely to remain fixed in the wound, instead of being withdrawn as the animal moves away. It is probable, then, that from these circumstances the fable of the spear-darting power of the porcupine took its rise.

The porcupine leads a solitary life, in obscure and lonely places, digging for itself a burrow, with many openings, in which it reposes during the day. Capable of burrowing, even in the firmest ground, its limbs are extremely muscular, and the claws are short, thick, and strong. The fore feet are divided into four distinct toes, a claw indicating the rudiment of a fifth; on the hinder feet there are five toes. The animal is ordinarily inoffensive, and is only formidable when actually assailed.

H. longicauda is a native of Sumatra. Acanthion javanica and A. hodgsoni are separated from the other species of the genus Hystrix as not having the neck crested. The former is found in Java, and the latter in Nepaul.

The African Brush-tailed Porcupine (*Atherura africana*) inhabits the Gold Coast district of West Africa. The greater part of the tail is bare both of hairs and spines, and covered only by flat, blackish scales, disposed in rings, the top alone being surmounted by a whitish-coloured tuft about two inches in length, composed of long, flat bristles, having the form neither of hairs nor quills, but closely resembling, as Cuvier has aptly remarked, narrow slips of parchment cut in an irregular manner.

Another species, A. fasciculata, is a native of India, of nearly the same size as the African species. Other species are found in Sumatra and Borneo.



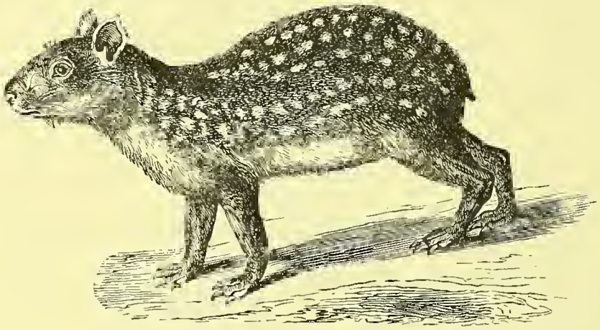
THE AGOUTI (*Dasyprocta aguti*).

SUB-FAMILY 2.—THE CAVIES (*Cavini*).

Professor Carus, following Mr. Waterhouse, places the Cavies and Agoutis in two distinct families, but in conformity with the arrangement we have adopted, we treat of them here together. The Agoutis differ from the Cavies in having the lip cloven, and the fore feet, in addition to the four toes, have a thumb-like wart. Commencing with the Agoutis; the Agouti (*Dasyprocta aguti*) is a native of British Guiana. It is about the size of a rabbit, to which it has some resemblance in its form and habits. Its general colour is of a grizzled reddish-brown, tinged with yellow on the neck, chest, and under parts, and on the shoulders and haunches. The legs and feet are nearly black, and the claws of a dusky grey. The hair on the face and legs is extremely short; but it increases in length as it approaches the crupper, where it measures three or four inches, and has much of the rigidity of a hog's bristles. It is, however, perfectly smooth, and lies flat on the surface of the body. The ears are short, rounded at their tips, naked, and rather flaccid; the line of profile is strongly curved, but not elevated so as to form a crest; the upper lip is deeply divided, and the lower jaw almost devoid of hair. The hinder limbs are considerably longer than the fore, but, as in the pacas, they are brought nearly to an equality by the application, in the former, of a lengthened portion of the sole to the surface of the ground.

Laborde and Sonnini affirm that in Guiana it is the most common quadruped, and forms one of the most useful articles of food to the colonists and natives. The former expressly says: "All the woods are full of it, whether upon the hills, on the plains, or in the marshes."

It rarely burrows in the earth, preferring to dwell in the hollow trunks of trees, or such retreats as require but little exertion to fit them for its use. In running it is extremely swift, taking long leaps like those of the hare, which it also resembles in the fineness of its fur and in its timidity. Its food consists principally of roots and fruits, and of the latter those of several species of palms appear to be its special favourites; but as to diet it is not very particular, and in captivity is readily brought to eat both fish and flesh. While feeding they sit on their hind feet, holding the food with their fore feet.

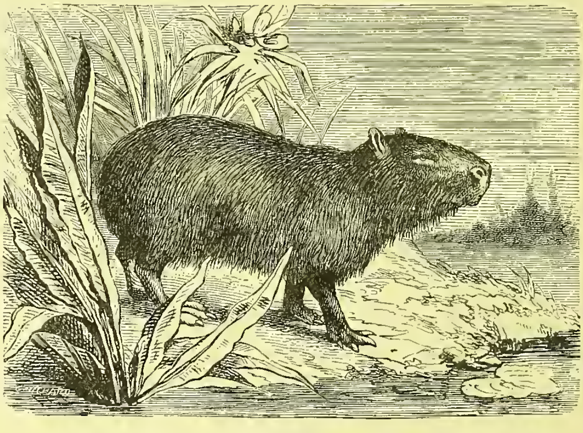


THE BROWN PACA (*Cœlogenys paca*).

The D. acouchy is also found in British Guiana; D. azaræ is from Southern Brazil; D. cristata is from South America; and D. antillensis (Sclater) inhabits the small West Indian Islands of St. Vincent, Lucia, and Granada.

The Paca (*Cœlogenys paca*) is found from Guatemala to Paraguay. It attains a length of about two feet; is of a dark brown colour or reddish, with white spots, which are placed on the sides of the body in four or five longitudinal rows. It differs from the agoutis in having cheek-pouches.

The pacas take up their abode in the forests, especially in the vicinity of water, and conceal themselves in superficial burrows, which their claws are well fitted for excavating. They are said to form three openings to each burrow, and to cover them up with dry leaves and branches. In order to take them alive, the natives stop up two of these openings and dig up the third; but the paca frequently makes an obstinate defence, and bites very severely. When undisturbed, it often sits up and washes its head and whiskers with its fore paws, which it licks and moistens with its saliva at each ablution, like a cat; and with these fore paws, as well as with the hind ones, it often scratches itself and dresses its fur.

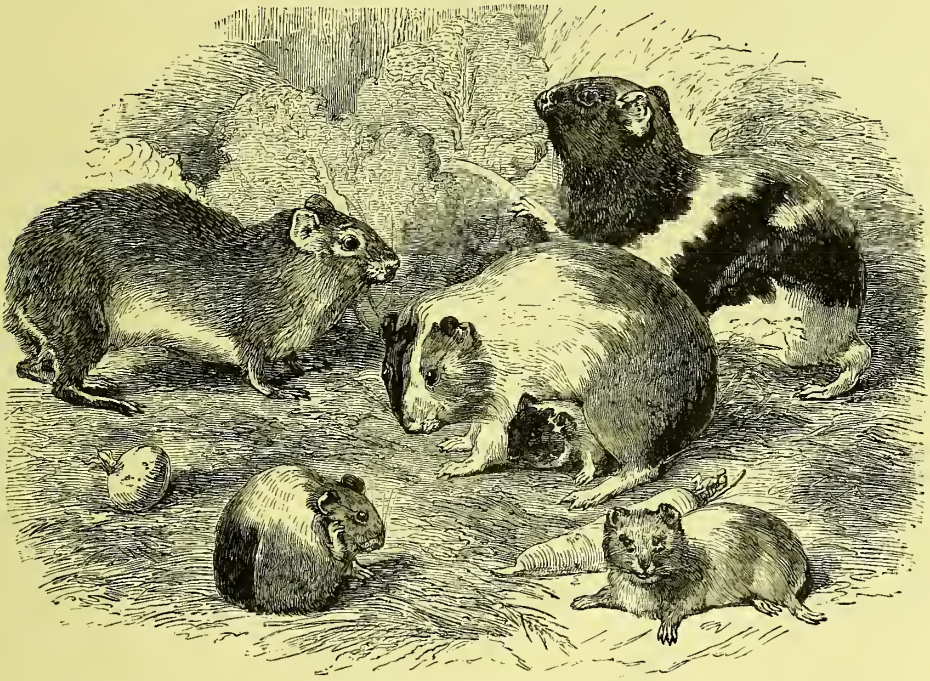


THE CAPYBARA (*Hydrochœrus capybara*).

It swims and dives remarkably well, and, although so heavy, runs with considerable swiftness. Its cry resembles the grunting of a pig; and this circumstance, combined with its mode of rooting in the earth with its nose, the bristliness of its hair, and the flavour of its flesh, probably gave rise to the comparisons made by the older travellers between the two animals. Its flesh is said to be very savoury, and forms a staple article of food in some parts of South America. It seldom quits its burrow except during the night, when it goes in search of its food, consisting chiefly of herbs and fruits. The sugar-cane plantations occasionally suffer much from its depredations. In captivity, according to M. F. Cuvier, no animal can discover less intelligence. When displeased, it throws itself violently at the offending object, and then makes a grumbling, which breaks out into a kind of barking. When it is not eating it is sleeping. It requires a soft and well-made bed, and to obtain this, it collects with its mouth hay, herbage, straw—anything, indeed, which suits its purpose, of which it makes a little heap, and then lies down in the centre of it.

Proceeding to the Cavies, we commence with the giant, not only of the race but even of the whole of the order of Rodents, for the Capybara (*Hydrochœrus capybara*) attains a length of from three to four feet.

It is a gregarious animal, frequenting the rich and wooded borders of the lakes and rivers in Brazil, Guiana, and Paraguay. Mr. Darwin states that it is common wherever there are large rivers or lakes over that part of the South American continent which lies between the Orinoco and the Plata, a distance of nearly 1,400 miles. It is not generally supposed to extend south of the Plata; but he heard that the capybara, provincially termed the carpincho, was found high up the Salado, and presumes that it has sometimes been seen south of the former river. These animals live on herbs and fruits; their habits are nocturnal; they swim across rivers and torrents in search of food, and raise so great a clamour as to terrify those who do not know the cause.



GUINEA PIGS (*Cavia cobaya*).

Humboldt, who calls these animals Chiguires, says, they live fifty or sixty together, in troops, on the banks of the Apure. "These animals, as large as our pigs, have no weapons of defence. They swim somewhat better than they run; yet they become the prey of crocodiles in the water, and of the tigers on land. It is difficult to conceive how, being thus persecuted by two powerful enemies, they become so numerous; but they breed with the same rapidity as the little cavies, or guinea pigs, which come to us from Brazil."

Stopping below the mouth of the Caño de la Tigrera to measure the velocity of the water at its surface, he was surrounded by capybaras, which swam like dogs, raising their heads and necks above the water. He saw with surprise a large crocodile on the opposite shore, motionless, and sleeping in the midst of these nibbling animals. It awoke at the approach of the canoe, and went into the water slowly, without these animals taking alarm. The Indians of the party accounted for this indifference by the stupidity of the capybaras; but Humboldt thought it more probable that they knew, by long experience, that the crocodile of the Apure and Orinoco does not attack on land, unless he finds the object he would seize immediately in his way at the instant when he throws himself into the water.

Continuing to descend the river, the party met with a great herd of capybaras which a tiger had put to flight, and from which he had selected his prey. These animals saw them land very unconcernedly; some of them were seated, and gazed upon them, moving the upper lip, like rabbits. They seemed not to be afraid of man, but the sight of Humboldt's dog put them to flight. Their hind legs being longer than their fore legs, their pace is a slight gallop, but so deficient in swiftness that two were caught.

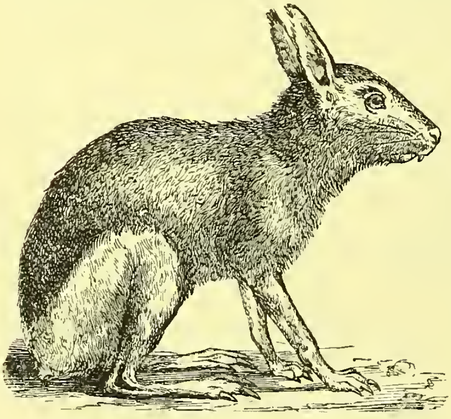
"In this animal," says Professor Owen, "the posterior grinders, like those of the elephant, present a greater number of component laminæ than the anterior ones, which are of earlier formation. Those of the upper jaw, according to the figure and description in the 'Ossemens Fossiles,' are composed of eleven laminæ, of which all but the first, which is notched externally, are simple. In the figure, too, it is worthy of observation, that the last or eleventh lamina is imperfect, and exhibits a construction analogous to the imperfectly-formed laminæ or denticles in the elephant's grinder, namely, a division into component columns."

The Guinea Pig (*Cavia cobaya*) is now better known in its domesticated form, but it is supposed to be but a variety of C. aperea, which is found wild in Brazil and Peru.

It frequents different kinds of stations, such as hedgerows made of the agave, or American aloe, and opuntia, or Indian fig, sand hillocks, and marshy places covered with aquatic plants, the latter appearing to be its favourite haunt. Where the soil is dry, it makes a burrow, but where it is otherwise, it lives concealed amidst the herbage. These animals generally come out to feed in the evening, and are then tame; but if the day be gloomy, they make their appearance in the morning. They are said to be very injurious to young trees. An old male killed at Maldonado weighed one pound three ounces.

Possessing but little intelligence, and very timid, this little animal is tamed without any difficulty. Azara, who kept one, remarks, that though he took no pains to render it familiar, it showed no fear whatever in his presence. It is to the ease with which it becomes domesticated that we owe its introduction into Europe, for, excepting that it is a pretty creature, it has no quality to render it a valuable acquisition. It is, however, eaten by the natives of Paraguay, who sometimes capture it by hundreds, when, driven from the lowlands by sudden inundations, it retreats for safety to the adjacent hilly grounds, where it finds neither shelter nor concealment.

This animal was supposed to have been originally imported from Guinea into England, and hence the name it has received. In a state of domestication it feeds on bread or grain, fruit or vegetables. It is very cleanly and harmless, and in disposition it is timid. But it appears totally void of attachment, not only to its benefactors, but even towards its own young, which it will suffer to be taken away, and even devoured, without discovering the least concern, or attempting any resistance.



THE PATAGONIAN CAVY (*Dolichotis patagonica*).

Guinea pigs lie flat on the stomach in taking their repose; and, like the dog, turn round several times before they lie down. They are exceedingly delicate, and impatient both of cold and moisture. Their usual voice is a kind of grunt, like that of a young pig, but their notes of pain are shrill and piercing.

The female breeds nearly every two months. Though provided with only two teats, she usually produces three or four, and sometimes as many as twelve, young ones at a birth. In the space of twelve hours the young ones are able to run about with as much agility as their parents.

The Rock Cavy (*Kerodon rupestris*) lives in the higher rocky regions of Brazil. It is smaller than the guinea pig, and has a short, close fur. Another species, K. kingii, is met with on the eastern coast of the Strait of Magellan.

The Patagonian Cavy (*Dolichotis patagonica*) is a native of sterile plains between

Mendoza and Patagonia. It has some resemblance to a hare, but differs especially in the high legs from the other cavies, which it surpasses in size. It is only where the country has a desert character that this cavy is common; and in the wilds of Patagonia little groups of two, three, or four may be continually seen hopping after one another in a straight line, over plains of gravel, thinly covered with a few thorny, dreary bushes, and a withered herbage. Azara states that this animal never excavates its own burrow, and always uses that of the viscacha; and Mr. Darwin considers that when that animal is present this statement is correct, but that on the sandy plains of Bahia Blanca, where the viscacha is not found, this cavy, as the Spaniards maintain, does its own work. This species is diurnal in its habits, roaming about by day. It is very shy and watchful, seldom squats after the manner of a hare, and cannot run fast, so that dogs of inferior speed easily overtake it. The female breeds in her burrow, generally producing two young ones at a birth. The flesh of this animal is white, but dry and insipid.

SUB-ORDER II.—DUPLICIDENTATI.

FAMILY LXIV.—LAGOMYIDÆ.

To this family belong some small species, mostly from the north-west of Asia. They differ from the hares and rabbits by having their ears short and rounded, having no tail, fewer molar teeth, and perfect collar-bones. They are chiefly dwellers in high mountain ranges, burrow in the ground, though sometimes only sheltering among loose stones. One species, the Russian Pika (*Lagomys pusillus*), just enters the eastern corner of Europe, ranging as far west as the Volga. It inhabits the southern districts of the Ural Mountains, and is found in Siberia as far as the Obi. Pallas tells us that they utter a chirping noise, which he compares to that of a quail. They are sometimes designated the Calling Hare.

Of another species, the Alpine Pika (*L. alpinus*), Pallas says that about the middle of the month of August these little animals collect, with admirable precaution, their winter's provender, which they bring near their habitation, and then spread out to dry, like hay. Nor is this all; for in September they form heaps or stacks of the fodder they have collected under the rocks, or in other places sheltered from the rain or snow. Where many of them have laboured together, their stacks are sometimes as high as a man, and more than eight feet in diameter. A subterranean gallery leads from the burrow, below the mass of hay, so that their communication with it cannot be intercepted by frost or snow. Pallas had the patience to examine the hay thus stored. He found it to consist chiefly of grasses and sweet herbs, all cut when most vigorous, and dried so slowly as to form a green and succulent fodder. He detected in it scarcely any ears or blossoms, or hard and woody stems, but some mixture of bitter herbs. The natives of Siberia are said to pilfer these for the subsistence of their cattle. This species is found on the Altai Mountains and to the confines of Asia.

L. nepalensis is a native of Nepal, and is found at a height of some 10,000 to 12,000 feet. The Ogotona of the Mongols (*L. ogotana*) is found in the country to the south of Lake Baikal.

The Calling Hare of America (*L. princeps*) is a native of the Rocky Mountains; and Mr. Lord describes a smaller species, L. minimus, with the same habitat. He is of opinion that the larger species does not construct a nest of hay for the winter, and that it lives at a lower altitude. The lesser one lives on the summit of the Cascade Mountains at about 7,000 feet high. It is shy and wary, at the slightest noise taking a header into a crevice. When everything is again quiet it cautiously peeps out, climbs to the top of a stone, and, sitting on its hind legs like a begging dog, gives a sharp, shrill, little cry. It was first seen in the month of October; the snows were just beginning, and these little fellows were all busily employed in making large nests of dry grass and leaves.

FAMILY LXV.—THE HARES (*Leporidæ*).

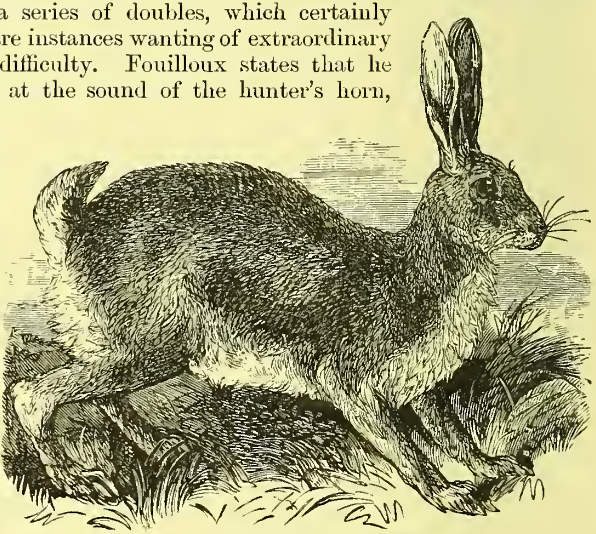
This family contains the well-known Hares and Rabbits. In addition to the characteristics of the sub-order, they have long ears, a re-curved short tail, hind legs longer than the fore legs, and imperfect clavicles. In common with the species of Lagomys, the molar teeth of the lower jaw, when the mouth is closed, are situated within the margin of the molars of the upper jaw, so that there is a larger lateral movement effected in the chewing of their food than in any of the other Rodents, which reminds one of the chewing of the cud of a Ruminant; and this lateral motion, which can be seen by watching a rabbit in the act of chewing, is facilitated by the free articulation of the condyle of the lower jaw. By this motion, too, the surface of the molars is unequally worn down. May not this have given rise to the idea that the hare chews the cud? In the only genus, Lepus, we include Blyth's Caprologus. There are some forty species. Baird records thirteen from North America; we can but mention the following:—

The Common Hare (*L. timidus*) is found in almost every part of Europe, with the exception of Ireland, Sweden, Norway, and Siberia. It is too well known to need description. Its habitual resting-place, called a "form," is sometimes a spot selected among fern and other plants, sometimes the underwood of "a preserve," and sometimes on the ground, with no other concealment than is yielded by the unevenness or rough condition of the site. Here it crouches during the day, and from hence it makes a regular track to its adjacent feeding-grounds, going and returning upon its own footsteps.

Towards evening it comes abroad in quest of food, and continues to search for it during the night. Where hares are numerous, their tracks, leading from preserves to their haunts, are so many and definite as to strike the eyes of the most unobservant, and the poacher is thus directed where to place his net or noose.

The hare feeds entirely on vegetable substances. It breeds when about a year old, and has three successive broods, each consisting of from three to five young ones, called leverets, which are born covered with fur, and with their eyes open.

Being comparatively defenceless, and having no burrow or fastness to which she can retreat, the hare trusts to her vigilance and great speed to enable her to elude her numerous enemies. If she is watched before the hounds, she will be seen to go straight away while in view, and then to commence a series of doubles, which certainly require no ordinary sagacity. Nor are instances wanting of extraordinary effort in circumstances of special difficulty. Fouilloux states that he saw a hare start from its "form" at the sound of the hunter's horn, run towards a pool of water at a considerable distance, plunge in, and swim to some rushes in the middle, where it lay down, and concealed itself from the pursuit of the dogs. That the hare is occasionally, at least, an accomplished and bold swimmer, is manifest from the following statement made by Mr. Yarrell: "A harbour of very great extent on our southern coast has an island, near the middle, of considerable extent, the nearest point of which is a mile distant from the mainland at high water, and with which point there is frequent communication by a ferry. Early one morning in spring, two hares were observed to come down the hills of the mainland towards the sea-side; one of which, from time to time, left its companion, and, proceeding to the very edge of the water, stopped there a minute or two, and then returned to its mate. The tide was rising, and, after waiting some time, one of them, exactly at high water, took to the sea, and swam rapidly over in a straight line to the opposite projecting point of land.



THE EGYPTIAN HARE (*L. egyptius*).

"The observer on this occasion, who was near the spot, but remained unperceived by the hares, had no doubt they were of different sexes, and that it was the male who swam across the water, as he had probably done many times before. It was remarkable that the hares remained on the shore nearly half an hour, one of them occasionally examining, as it would seem, the state of the current, and ultimately taking to the sea at that precise period of the tide called slack water, when the passage across could be effected without being carried by the force of the stream either above or below the desired point of landing. The other hare then cantered back to the hills."

The Irish, or Mountain Hare (*L. variabilis*), is found in Ireland, Scotland, the north of England, the Swiss Alps, Norway and Sweden, and in many parts of the north of Russia and Siberia. It is a little larger than the common hare, with a shorter tail, which sports the distinctive black patch on its upper surface. In winter it often changes from the brown hue of its summer coat to a pure white, the ear tips remaining black. The Irish variety is of a richer and more uniform colour on the upper parts, and it is sometimes met with in a state of white fur. The Sardinian Hare (*L. mediterraneus*) is a common species on the island of that name. Of the Asiatic species we may mention L. nigricollis, found throughout the Peninsula of India, and L. oiostolus, a native of the snowy regions of the Himalaya. The Egyptian Hare (*L. ægyptius*) is a native of Egypt and Abyssinia, but the species of this genus do not extend much beyond the north-east corner of Africa. The Polar Hare (*L. glacialis*) is a native of the region round the Polar seas of America; it is also met with in Greenland, and is said to occur in Newfoundland. The Sage Hare (*L. artemisia*) occurs in the regions west of the Missouri to the Rocky Mountains. For information about the American Hares the reader should consult Dr. Baird's monograph.

RABBITS (*L. cuniculus*).

Of the Rabbits, the Common Rabbit (*L. cuniculus*) is very numerous in every part of the British Islands, is common in France, very abundant in Spain, believed to be nowhere wild in Switzerland, and is indigenous to North Africa. Some think that it was brought from Africa to Spain, and then was introduced into Great Britain. That they were at one time a costly article of food in these countries seems proved by the fact that, in the year 1309, at the installation feast of the Abbot of St. Austin's, six hundred rabbits were provided at the great cost of £15; sixpence, the cost of each, being the then common price of a pig.

The rabbit may at once be distinguished from the hare by the comparative shortness of the head and ears, as well as of the hinder limbs, the absence of a black tip to the ears, and also by the brown colour of the upper surface of the tail. Its habits are totally opposite to that of the hare. Its flesh, instead of being dark and highly-flavoured, is white and somewhat insipid, especially that of the tame breed. It is eminently gregarious. As is well known, it makes extensive burrows, in which it habitually dwells, and rears its young. Sandy soils, with a superficial layer of fine vegetable mould, clothed with thyme, fine grass, and other herbage, which are alike easily mined and afford food, are favourable spots for these animals.

A rabbit-warren—that is, a wide sandy heath or extensive common, left for their increase and feeding—presents an amusing spectacle when visited at the close of the day or by the light of the moon. Hundreds of all sizes may be seen gambolling and sporting, and chasing one another with astonishing rapidity. When alarmed, their flight to their burrows is instant and surprising.

Unlike the other species of the genus, the young rabbits are born blind and naked, and totally helpless. The female forms a separate burrow, at the bottom of which she makes a nest of dried grass, lining it with fur taken from her own body. In this nest she deposits her young, carefully covering them over every time she leaves them. It is not until the tenth or twelfth day that the young are able to see; but they do not leave the burrow till they are four or five weeks old. The precaution of forming a separate burrow, the entrance of which is concealed, is to protect them from the male parent, who will destroy the young, should he chance to discover them.

The Rev. W. Houghton, in an article on the rabbit as known to the ancients, concludes that it was not a native of either Greece or Italy in early times, or prior to A.D. 230.

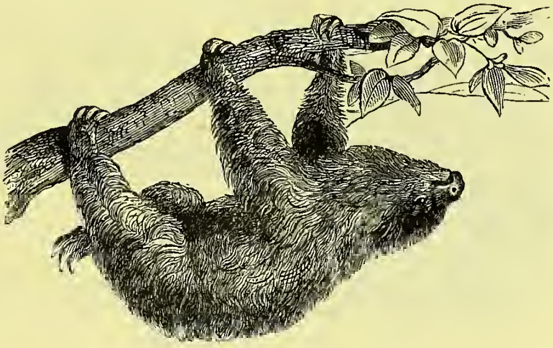
THE COMMON HARE (*L. timidus*).

ORDER XI.—TOOTHLESS ANIMALS (*Edentata*).

In conformity with usage, we give this name to the order containing the Ant-eaters and Armadillos, though we would prefer one less open to objection, for the animals belonging to this order are not, as the name would indicate, all toothless. On the contrary, in many, teeth are well developed. The front portion of both jaws is, however in all, destitute of these appendages, and sometimes both jaws are edentulous. There are therefore no incisor nor canine teeth (with one or two exceptions); all the teeth are simple, without roots, and with a hollow base—they are thus ever growing as they wear. They consist of dentine and cement, having no covering of enamel. The limbs are four in number, free, with the toes united to the very claws, which are large, curved, often compressed. The order, all the species in which are inhabitants of the warmest countries of the earth, and principally of South America, may be divided into the following five families :—

FAMILY LXVI.—BRADYPODIDÆ.

This family contains the Sloths, which live in the large tropical forests of the eastern side of South America, none being found to the west of the Andes. They have a flat short face, with long legs (especially the anterior), and long incurved claws. In some, there are canine teeth; the tongue is largely extensile; they feed on leaves, and have bodies covered with a dry crisp hair. The female bears only a single young one at a time, and carries it, as long as it continues to suckle, on its back. According to Dr. Gray, there are the following genera and species :—The Two-toed Sloth (*Cholopus didactylus*), from Brazil and Guiana. Hoffmann's Sloth (*C. hoffmanni*) is described from Porto Rico by Professor Peters; it has, apparently, only six cervical vertebræ. The Three-toed Sloth (*Bradypus crinitus*) is a native of Brazil, Para, and Rio Janeiro. Mr. Birchall, writing in the "Zoologist," says that a female that he had in custody brought forth a young one, which she did not carry on her back, but in her lap; still it appeared to him that when the young one was older the parent's back would be the more convenient place, with its long arms round her neck and its legs round her waist. This species has a mane of long black hair on the back of its neck.



THE SLOTH (*Bradypus crinitus*).

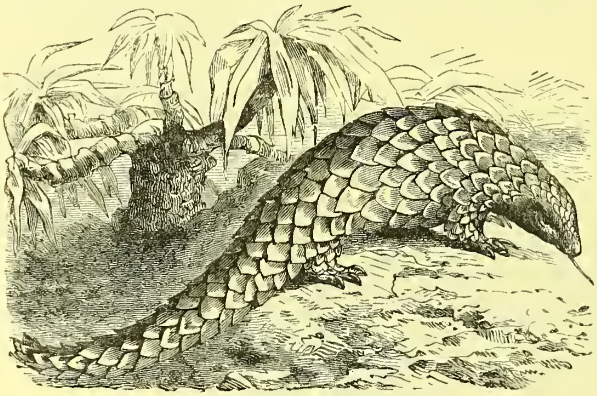
The Yellow-throated Ai (*Arctopithecus cuculliger*) is a native of Guiana, Demerara, and Bolivia. A. gularis, from Surinam, is but little known. A. blainvillei is probably the species known to Buffon, and is found in Brazil. A. boliviensis is from Bolivia; A. marmoratus, from Brazil. A. castaniceps was found by the lamented Dr. Seeman at Nicaragua. The following letter about this remarkable species is too interesting to be omitted :—

"Dear Sir,—The Sloth (Arctopithecus) I brought home was caught in the woods surrounding the Javali gold-mine in the Chontales district of Nicaragua, about 2,000 feet above the sea-level, a country having nine months of rain during the year. The natives call this animal 'Camaleon,' and say that it is very rare: which may be the case, as during all my travels in the country I have never met with it before. But, on the other hand, it should be borne in mind that it has almost exactly the same greyish-green colour as 'Tillandsia usneoides,' the so-called 'vegetable horse-hair' common in the district; and if it could be shown that it frequented trees covered with that plant (a point I hope to ascertain during my visit in June next), there would be a curious case of mimicry between this sloth's hair and the Tillandsia, and a good reason why so few of these sloths are seen. When the animal first came into my possession it was much greener than its preserved skin is now, which has been dried over the fire, and it remains to be seen whether the greenness is owing, at least in part, to the fact that the hair becomes covered with minute cryptogamic organisms, the damp climate and thick gloomy forests being favourable to their growth. I had no microscope with me to clear up this point; but this you will, of course, easily ascertain. I had the animal alive for about a month, feeding it on the young leaves of Cecropia peltata, an urticaceous fast-growing tree of the district; and it used to eat most during the night, when it was also most lively. One night it escaped from its prison, and next morning was found about 800 yards off, in a water-butt, whither it had to make its way over a cleared hill, where there were no shrubs or trees, which rather puzzled me. During my temporary absence from Javali the servants neglected to feed it, or else I had hoped to bring it to London to present it to Dr. Sclater. It had great strength; and in order to pull it away from the tree to which it was holding, your hands were necessary. On those occasions it used to utter a shrill sound, like a monkey; but I have never, on any other occasion, heard it uttering this sound."

A. griseus occurs at Costa Rica, and has been found by Mr. Salvin at Veragua; A. flaccidus from Venezuela and Para. The student will find most of these species figured in the "Proceedings of the Zoological Society of London" for 1871, the three latter species belonging to the sloths, the males of which have a coloured patch on their back.

FAMILY LXVII.—MANIDIDÆ.

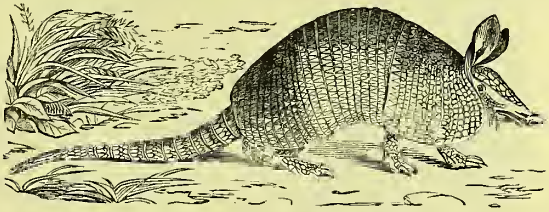
The Scaly Ant-eaters form a remarkable family of Edentates scattered over the warm regions of Asia and Africa. They can, when danger approaches, roll themselves into a ball, and are then well protected by their armour of scales. The tail is flat and expanded, ears very small, tongue exsertile; they have no teeth. The toes are bent up, and they walk on the outer edge of the feet.



THE PANGOLIN (*Manis longicauda*).

The Pangolin (*Manis longicauda*) is a native of Guinea and the Gaboon district. M. tricuspis extends on the west coast of Africa from Sierra Leone to Fernando Po: the form occurring on this island is by some regarded as a distinct species. Of the four species of Philodotus, three are peculiar to Asia. P. dalmannii seems to be the most northern species, being found in China. P. javanicus is a native of Sumatra, Java, and Borneo. "In Borneo it is called Pengoling, which means an animal rolling itself up. There it inhabits hollow trees, and feeds on ants alone, of which it consumes thousands. It is a slow-moving animal, but very strong, and by means of its powerful prehensile tail (which is crowned with a little naked callosity) climbs tolerably well among rocks and dead trees. The tongue is exceedingly long, round, and fleshy, and is used to obtain its food by its being laid across the tracks of ants, which stick to a glutinous secretion with which it is provided." We have taken this extract from the only published part of a "Natural History of Labuan," by Messrs. Motley and Dillwyn, but we do not know what to make of the powerful prehensile tail. The Indian Pangolin (*P. indicus*) is found from Madras, through Bengal into Assam. We wish space would allow of our giving an extract from Mr. Tickell's account of its habits and peculiarities. The Ipi (*P. giganteus*) is met with on the west coast of Africa, along the banks of the Niger, and at Cape Coast Castle: it is sometimes met with upwards of five feet in length. Smutsia temminckii is the pangolin of the eastern side of Africa, being found at Sennaar, and as far south as Caffraria. At one time it was probably scattered over the whole of South Africa. Dr. A. Smith accounts for its extreme scarceness by the fact that the natives believe it to be unlucky, thinking either that it has some influence on their cattle, or else that certain observances in respect to it have an effect on them. Whenever they secure a specimen it is immediately burned in some cattle pen, which, according to the opinion of the sacrificer, tends to increase the health and fertility of all cattle who may afterwards enter that fold. When discovered, it never attempts to escape, but instantly rolls itself up in a globular form, taking special care of its head, which is the only part that is easily injured. Ants constitute its chief and favourite food, and these it secures by extending its projectile tongue into holes which may exist in the habitations of these insects, or which it may itself form, and when, by means of the glutinous matter with which its tongue is covered, a full load has been received, a sudden contraction of the retractor muscles carries both into its mouth, after which the little animals are immediately swallowed. The genus is called after Smuts, the earliest investigator of the mammals of South Africa.

FAMILY LXVIII.—THE ARMADILLOS (*Dasypodidæ*).


THE PEBA ARMADILLO (*Tatusia peba*).

The Armadillos are essentially South American animals; their bodies are encased in a hard mail, formed of regular dense scale-like bodies, mostly hexagonal; the back often divided into rings of these scutæ. Some of them walk on their toes, and are not unlike little pigs; others walk on the palm and soles of their feet. About eighteen species are known. Among these, the Peba Armadillo (*Tatusia peba*) is found throughout Central and South America. It lives on both animal and vegetable food, burying both for some time before eating them, and is nocturnal in its habits. Dr. Baird says that the people of Matamoras esteem its flesh, and the women attribute imaginary properties to its shell. Other species are S. hirsuta, Guayaquil; T. hybrida, very common in Paraguay, and extending to North Patagonia; and P. kappleri, Surinam.

The Tatou (*Prionodontes gigas*) is the Giant Armadillo of Surinam, and grows to a length of from four to five feet. It is also found in Paraguay and Brazil.

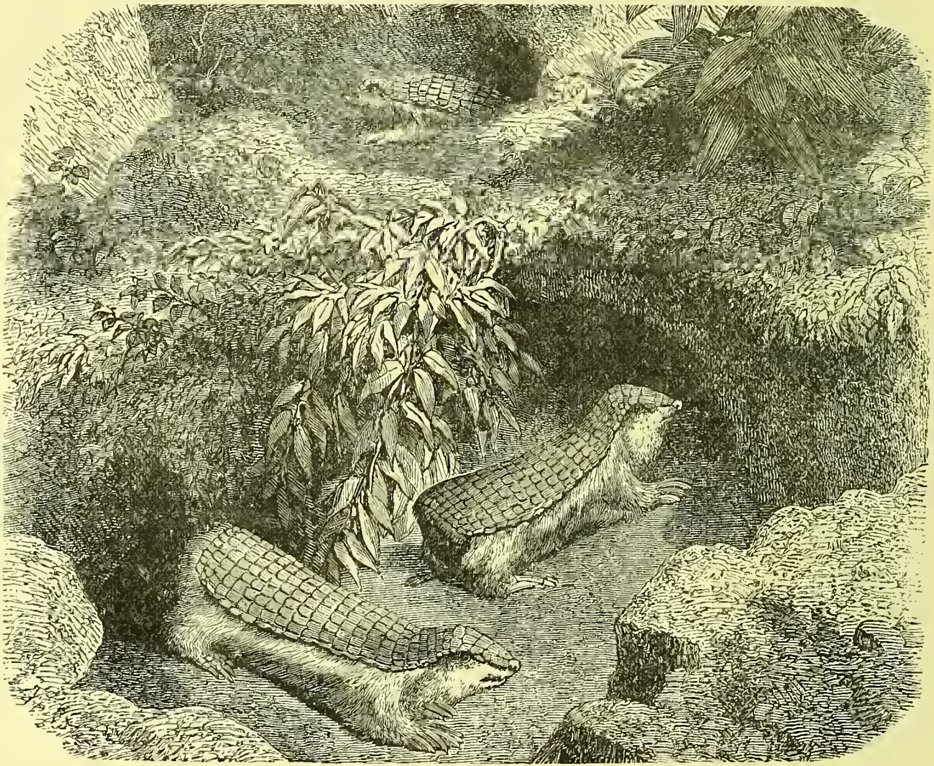
The Six-banded Armadillo (*Dasypus sexcinctus*) is a native of Brazil; the Long-haired Armadillo (*D. vellerosus*) comes from Mendoza; the Hairy Armadillo (*D. villosus*), the Pampas of Buenos Ayres; and the Little Armadillo (*D. minutus*), La Plata. The two latter are also Chilian. The first, Mr. Darwin says, is nocturnal, while the latter wanders by day over the open plains, feeding on beetles, larva, roots, and even on small snakes. The little one prefers a very dry soil and the sandy dunes near the coast, where for many months it can never taste water. In soft soil the animal burrows so quickly that its hinder quarter would almost disappear before one could alight from one's horse. In the course of a day's ride several would be met with. While rolled up it is safe from the attacks of dogs; for a dog not being able to take the whole of it in his mouth, tries to bite one side, and the living ball rolls away. Xenurus unicinctus and X. hispidus are found in Brazil.

The three-banded armadillos can bend their body so as to form nearly a sphere, the shield on the head and the short tubercular tail filling up the aperture occasioned by the notches left by the shoulder and pelvic shields. They walk on the small end of the elephant-like hind feet, and on the tips of the long, slender, middle claws of the fore feet. The under side of their bodies is covered with long bristly hairs, and the outer plate of the movable rings has a fringe of rigid hairs. The bodies of the males seem more elongate than those of the females. They are very active, running with rapidity. They are called Satubola by the Brazilians. The best known species is the Three-banded Armadillo (*Tolypeutes tricinctus*), from Bolivia and Buenos Ayres. Another species, T. conurus, is found in La Plata.

The Pichiciago (*Chlamydophorus truncatus*) is an animal about the size of the common mole, found near Mendoza in La Plata, which mostly keeps underground. Its back is covered with a coriaceous test (dorsal disk), which is composed of transverse rows of scutæ. The tail is rigid and bent under the body; the dorsal disk is attached along the middle of the back, and the body is covered with silky hair on the sides. Professor Hyrtl gives a full account of the anatomy of this very rare and extraordinary animal in a memoir published by the Vienna Academy in 1855. A second species (C. retusa) has been described by Dr. Burmeister from Santa Cruz de la Sierra, Bolivia. It has the dorsal shield attached by its edge to the skin of the back. The pelvic disk, on which both species rest, is not so well covered with scales; nor is the tail. The hair appears to be more woolly than silky, and it is a little larger in size than the former species.

FAMILY LXIX.—ORYCTEROPODIDÆ.

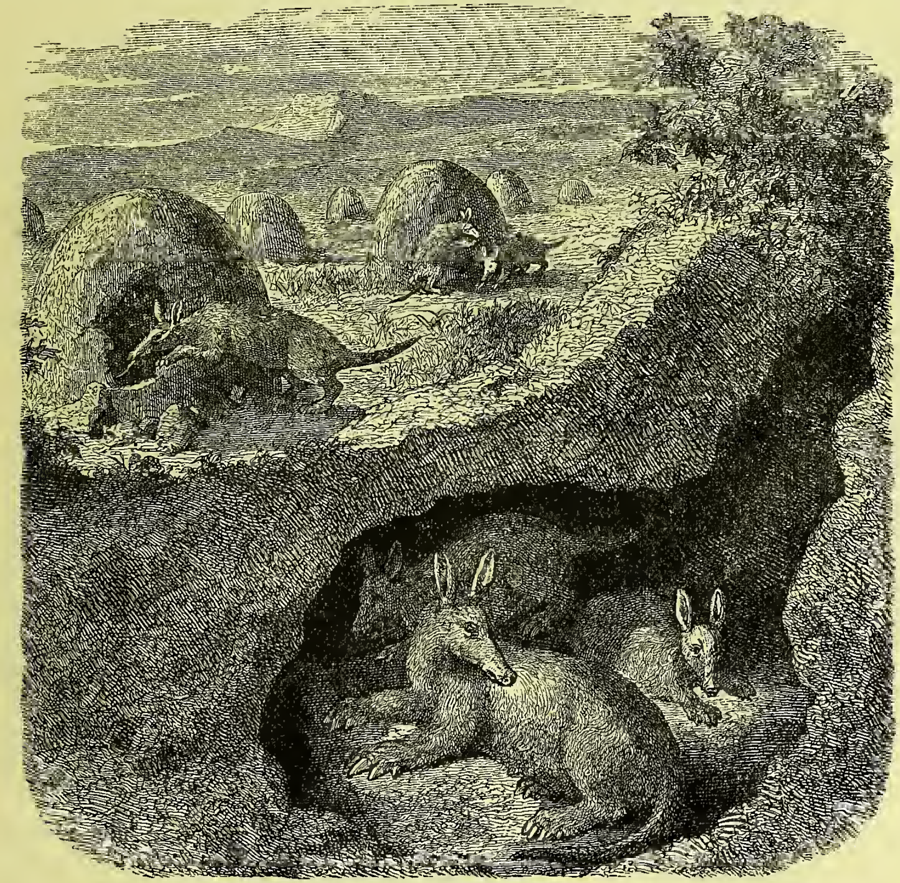
This family is formed to contain two species of the genus Orycteropus, both being hairy ant-eaters, found in Africa. We have seen that among the scaly ant-eaters the Old World had its representatives, so in this family it has representatives of the hairy type. The Cape Ant-Bear, or Aard-Vark (*Orycteropus capensis*), is found at the Cape of Good Hope. It lives in subterranean cavities, and attains a length of four feet and more. It has neither incisor nor canine teeth, but has numerous molars, which are cylindrical, have flat crowns, and seem to vary with age. The body is covered with bristles; the ears are long and pointed; the tail is thick and hairy; the feet are short, the anterior with four, the posterior with five toes, and all furnished with strong, digging, hoof-like claws. A second species is found in North-east Africa, and possibly extends across the whole of Africa, from Senegal to Abyssinia.



THE PICHICIAGO (*Chlamydophorus truncatus*).

FAMILY LXX.—THE ANT-EATERS (*Myrmecophagidæ*).

These are the true ant-eaters, and are only found in the tropical regions of South America. They are typical Edentates, having no teeth. Their bodies are covered with hair; the tail is long, sometimes bristly, sometimes prehensile; the head is conical-shaped and long; mouth, small; ears, small. They feed on ants and termites, whose nests they tear up with their long nails, catching them with their long extensile tongue, which is covered with an adhesive mucus. The Great Ant-eater (*Myrmecophaga jubata*) is found throughout La Plata. It is the terrestrial form of this family, walking on the ground on the side of its feet, with its claws turned up out of the way. It is about four feet in length, with a tail which is two feet and a half more. This tail is covered with long bristly hair. Of the arboreal or tree-climbing form we have the Tamandua Ant-eater (*Tamandua tridactyla*), occurring in Brazil and Paraguay. A specimen in the London Zoological Gardens was from Santa Martha, and was about twenty inches in length, with a tail just as long as its body. The fur on the body and tail is short; the nose is long and tapering. A second species of this genus (*T. longicaudata*) is only known from skins which want a habitat.



CAPE ANT-BEAR (*Orycteropus capensis*).

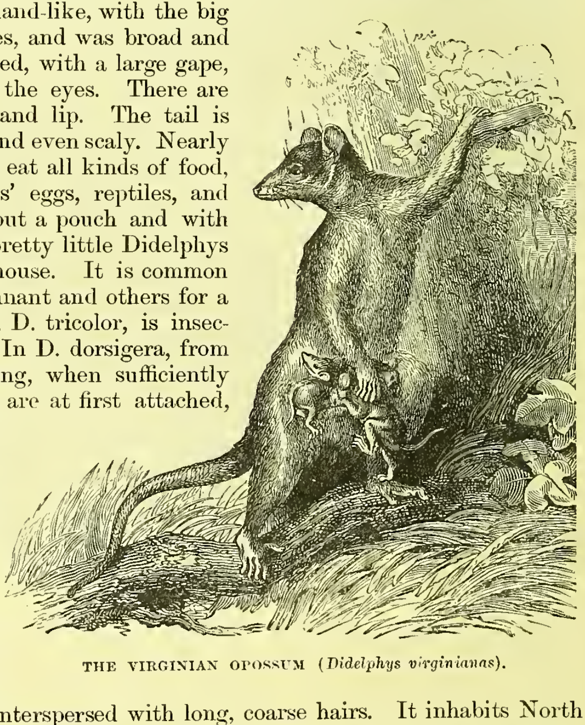
The Little Ant-eater (*Cycloturus didactylus*) is not uncommon in the Brazils. It has two toes on the front and five on the hind feet, the outer front one much the longer. The snout is short, and the hair is silky. A second species (*C. dorsalis*) was found by Mr. Salvin in Costa Rica. It is of a golden-yellow colour, with a broad, well defined, dark dorsal stripe.

ORDER XII.—ANIMALS WITH POUCHES (*Marsupialia*).

The animals belonging to this order are distinguished from all other Mammals by the fact that in the females the mammæ are ventral, and contained either in a pouch, or are placed between two oblong, cutaneous folds of the abdomen, which takes the place of a pouch. The young are born of a very small size, and in an imperfect condition. They are transferred to the pouch, where from a long teat they are supplied with milk, at first forced into their mouth, and afterwards obtained by the act of sucking. In almost all the furcular portion the collar is perfect, and yet the coracoid portion is always anchylosed with the shoulder-blade, and is not articulated with the sternum. There are incisor and molar teeth in all; canine teeth in some. Besides the anatomical peculiarities referred to, there are many other osteological ones, some of which have been incidentally alluded to in the introductory chapter. With the exception of the Opossums, which are a most peculiar, and, in some respects, aberrant family of Marsupials, all the species of this most varied order are nocturnal animals, confined to the region of Australia. In our sub-division of this family into sub-order of families we closely follow Mr. Waterhouse.

FAMILY LXXI.—THE OPOSSUMS (*Didelphidæ.*)

The True American Opossums were placed in a group called Pedimana by Wagner, and this group was placed near the Quadrumana by Mr. Ogilby, because the feet being pentadactylous, the posteriors were hand-like, with the big toe apart, opposable to the other toes, and was broad and without a claw. The head is produced, with a large gape, which extends to the outer angle of the eyes. There are a few long bristles at the nostrils and lip. The tail is furred at its base, elsewhere naked and even scaly. Nearly all the species are American. They eat all kinds of food, principally insects, birds, and birds' eggs, reptiles, and also fruits. Of the opossums without a pouch and with a short tail, we may mention the pretty little Didelphys tri-striata, not much larger than a mouse. It is common in Brazil, and was mistaken by Pennant and others for a shrew. A somewhat larger species, D. tricolor, is insectivorous, and is found in Guiana. In D. dorsigera, from Surinam, the tail is long. The young, when sufficiently old to leave the teats, to which they are at first attached, are carried by the parent on her back, where they retain their position by means of their little prehensile tails, which they entwine round that of their mother. This is probably also done in the case of all the pouchless opossums. Of those with pouches the best-known is the Virginian Opossum (*D. virginiana*). It is one of the largest of the genus. Its form is robust. It is covered with long woolly fur, interspersed with long, coarse hairs. It inhabits North America, being found from the Southern States to Mexico. It is very destructive to poultry, sucking their blood without eating the flesh. It also feeds on roots and wild fruits. It can hang suspended by its tail, and has great power of feigning death. D. cancrivora is a native of Brazil. It prefers marshy ground, and feeds on crabs, reptiles, and birds. There are upwards of twenty species of this genus described.



THE VIRGINIAN OPOSSUM (*Didelphys virginianas*).

The Yapock, or Water Opossum (*Chironectes yapock*), is found about the smaller rivers of Guiana and Brazil. It is about a foot in length, with a tail somewhat longer than its body. The hind feet are very large. The toes are long, and tied together by a broad membrane, which terminates near the base of the claws. The big toe is large and has no nail. It has large cheek-pouches. It is said to feed on crustacea.

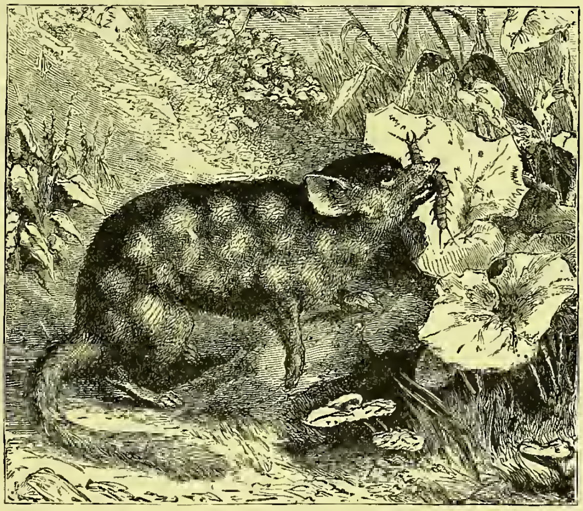
FAMILY LXXII.—THE DASYURES (*Dasyuridæ*).

The species of this family are either exclusively Australian or at most extend only as far north as New Guinea and the adjacent islands. The tail is never prehensile. The canine teeth are longer than the incisors. The big toe on the hind foot is very small, and often wanting. In the species of the genus Phascologale there is no pouch, the young being protected by the hair alone of the mother's body. P. penicillatus is found over a great part of the coast of Australia, except the north, and lives in trees. It is about the size of a rat, and frequently enters houses. P. calura is found in the interior of Australia.

Antechinus minutissimus, from the east of Australia, is the smallest species of this order. It is about four inches and three-quarters long, of which the tail, which is covered sparingly by short hairs, is one-half. Mr. Kreft, in his analysis of this family, enumerates nine species of this genus. Podabrus fuliginosus is a native of West Australia: the species (seven) of this genus appear to be terrestrial. Antechinomys lanigera, from the lower River Murray district, is terrestrial, and has only four toes on the hind foot. Chœtocercus cristicauda, from Southern Australia, has a general appearance like a Phascogale, but has a tail nearly as long as the body, with a crest of black hair on the apical half. (Plate XXXVI., "Proceedings of Zoological Society," 1866.)

The Native Devil of the colonists is Sarcophilus ursinus. It is a native of Tasmania. It is black, with a white patch on the breast between the fore legs, with a bunch of very long hair between the eyes. The head is large. It is nocturnal, very fierce, and a match for an ordinary dog.

The Dasyures are chiefly found in Tasmania and New South Wales. They are small animals, about the size of a cat, with spotted skins and long tails. D. maugei is about as big as a rabbit, with a bushy tail clothed with long yellow hairs mixed with black.


THE DASYURE (*Dasyurus maugei*).

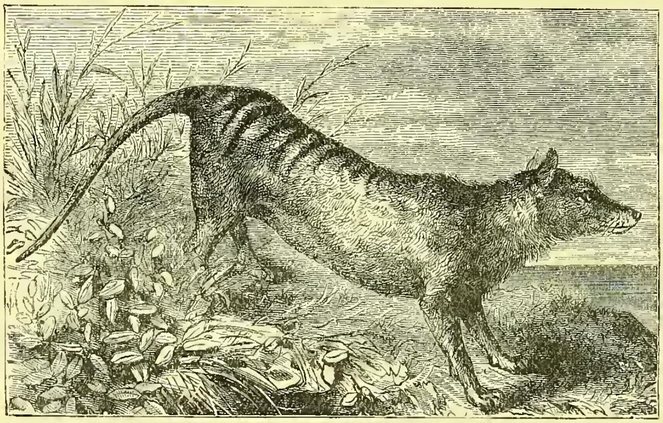
The Tiger, or Striped Wolf of the colonists (*Thylacinus cynocephalus*), inhabits Tasmania, where it was at one time common. It is about the size of a wolf, with a dog-like head and slender tail, which is nearly as long as the body. It is of a pale brown hue, with numerous black transverse marks. It inhabits deep and gloomy glens in the mountainous districts of Tasmania, living in caverns, preying on the brush kangaroo and other animals.

FAMILY LXXIII.—MYRMECOBIIDÆ.

The only representative of this family is a little animal (*Myrmecobius fasciatus*) about the size of a squirrel, of a grey-brown colour; the feet rusty red; the dark brown of the back striped with five to seven cream-coloured bands; the under parts of a yellowish-white; tail long and bushy. It was discovered by Mr. Dale, to the south-east of the Swan River. It has fifty-two teeth, the largest number of any known mammal, if we except some of the Cetacea and the Armadilloes. The feet are armed with strong claws, and there can be little doubt that it lives on insects, probably ants. This little animal would seem to be the representative in the order of an Edentate type.

FAMILY LXXIV.—THE BANDICOOTS (*Peramelidæ*).

The Bandicoots are little insectivorous kangaroos, but with simple stomachs, the pouch opening backwards instead of, as in the other marsupials, forwards. The fore feet are pentadactylous (save in Chœropus), with the outer toe apart, very short; hind feet long, with pollex very short, clawless, or wanting.


THE THYLACIN (*Thylacinus cynocephalus*).

The Long-nosed Bandicoot (*Perameles nasuta*) is a native of Tasmania. P. gunnii is a closely-allied species from the same locality. Their food is chiefly insects.

The Rabbit-eared Bandicoot (*P. lagotis*) is met with in West Australia. P. dorcyanis is a native of New Guinea.

The Chœropus castanotis (Gray) is a small animal, about thirteen inches long, the tail counting about one-third of this, found in South-west and East Australia, and described in 1838 by Mr. W. Ogilby. It was found by Major Mitchell, in June, 1836, on the ground, but on being chased took refuge in a hollow tree. The dentition is nearly as in Perameles; the opening of the marsupium is as in that genus. The feet are slender; the hind feet want the big toe; the fore feet have only two toes, and hence look quite pig-like. It may be observed in passing that this is the only species of marsupial of which the fore feet have fewer than five toes. For a beautiful figure of this animal the reader can consult Mr. Gould's great work on the Mammals of Australia.

FAMILY LXXV.—THE KANGAROOS (*Macropodidæ*).

The Kangaroos form the largest family of the marsupials. All of them are found either in Australia or New Guinea, and the adjacent islands. One species, from the Aru Islands, was described in 1714 by De Bruyn and Valentin, but since then many species have been discovered in Australia and Tasmania, and nearly sixty species are at present known. The animals belonging to this family are remarkable for the slightness of make of the anterior portions of their body, the smallness of their anterior limbs, and for the great size of their posterior extremities and of their tail. When at rest the head and thorax are slightly inclined forward, the animal resting upon the tail and feet. The anterior extremities are prehensile and clawed, having five fingers: the two outer the shortest, the central the longest. The hind feet are furnished with one very large central toe, an outer smaller and shorter, but both armed with a nail-like claw; on the inner side of the foot are two small slender toes, with separate nails, not included in the one integument. These latter are used by the animal to clean its fur. They live on grass and leaves. For an account of the species one should consult Mr. Gould's large work on the Kangaroos. Both in this work and in Mr. Waterhouse's History of Mammalia, this family is divided into ten genera.

THE GIANT KANGAROO (*Macropus giganteus*).

The Great Kangaroo (*Macropus giganteus*) was discovered in 1770, during Captain Cook's first voyage, whilst that celebrated navigator was stationed on the coast of New South Wales to repair his vessel. A party from the ship, in search of pigeons for the sick, saw an animal which they described to be as large as a greyhound, of a slender make, of a mouse colour, and extremely swift. Both Cook and Sir Joseph Banks afterwards saw it; and Mr. Gore having been so fortunate as to shoot one, a drawing was made, which appears in the narrative of the voyage. This kangaroo is a native of New South Wales, Southern and Western Australia, and Tasmania. It prefers low grassy plains and open districts, browsing upon the herbage; during the day it shelters itself among the ferns and bushes. They are timid, and not easily approached. When in an open country and flying from its enemies, it is said to make leaps to the distance of fifteen feet or more, its body being outstretched nearly horizontally, and the great tail in the same direction: the latter not applied to the ground, but serving as a balance. It is gregarious, according to some; but others account for it occurring in flocks by the abundance of food in certain spots. From the tip of the nose to the root of the tail an adult male will measure about five feet three inches, and a fully-grown female about three feet six inches. This species, with M. melanops and M. rufus, are often seen in collections, and all three have produced young in the London Zoological Gardens.

The Antelope Kangaroo (*Osphranter antilopinus*), with short fur, the hairs stiff and closely applied to the body, inhabits North Australia. Another species, O. isabellinus, is a native of the West Coast.

Bennett's Wallaby (*Halmaturus bennettii*)—the Brush Kangaroo, as it is called by the natives—is universally dispersed over Tasmania, and at one time thousands of its skins were sold yearly at from fourpence to sixpence each, yet its retreats in the dense forests of Tasmania are so secure, that it is scarcely possible that it can be exterminated. For many years specimens have bred, and the young have been reared, in the London Zoological Gardens. An adult male stands about three feet high. Another species, the Derbyan Wallaby (*H. derbyanus*), is a native of the islands of the West Coast of Australia. About eighteen species of this genus are known; they are all either Tasmanian or Australian.

The Yellow-legged Rock Kangaroo (*Petrogale xanthopus*, Gray) seems very common in South Australia; it is about the same size as the Brush-tailed Kangaroo (*P. penicillatus*), which was first found by Sir E. Parry on the Liverpool Plains of New South Wales, where, Mr. Gould has seen them leaping from rock to rock, often alighting on ledges so slight and narrow that it appeared almost impossible for them to retain their footing. They appear to be strictly nocturnal in their habits. An adult male is about two feet four inches from tip of nose to root of tail. All the (seven) species of this genus are Australian.

Of the Tree Kangaroos only two species are at present known—the Ursine Tree Kangaroo (*Dendrolagus ursinus*) and the Brown Tree Kangaroo (*D. mustus*)—both natives of New Guinea. They both ascend trees to feed on their leaves, for which habit their strong fore legs, with their curved and powerful claws, are adapted. The fore legs are but little inferior in size to the hind legs. Their tail is very long. The fur is long and coarse.

Le Brun's Kangaroo (*Dorcopsis brunii*) was the first of the family with which naturalists were acquainted, having been figured and described by Le Brun in 1711, half a century before Captain Cook's first voyage. The tail is shorter than the body, is rather thick, ringed with scales; towards the apex it is naked. It is a terrestrial kangaroo, and is found in New Guinea and the Aru Islands. Le Brun saw it in captivity at Batavia. A second species has lately been described from New Guinea.

The Lunulated Kangaroo (*Onychogalea lunulata*) is a native of Central Australia. It is a beautiful and graceful little kangaroo, about two feet in height; the tail longer than the body, slender, and furnished at the apex with a horny excrescence. It has a short fur, and is very prettily marked. There are two other species.

The genus Lagorchestes contains four or five species of small hare-like kangaroos. They have the end of the nose not naked, but clothed with velvet-like hairs. Their feet and claws are small and slender, so that they are probably not burrowing animals. The Hare Kangaroo (*L. leporoides*), like the other species, inhabits the North-west and South of Australia. It is nearly equal in size to the common hare, which it resembles, too, in the texture and colouring of its fur. It is also hare-like in being solitary in its habits, and sitting close in a well-formed seat. While out on the plains in South Australia, Mr. Gould started a hare kangaroo before two fleet dogs. After running to the distance of a quarter of a mile, it suddenly doubled, and came back upon him, the dogs following close at its heels. Mr. Gould stood perfectly still, and the animal had arrived within twenty feet ere it observed him, when, to his astonishment, instead of branching off to the right or to the left, it bounded clear over his head, and, on descending to the ground, he fired, and secured the specimen.

The Tasmanian Rat Kangaroo (*Hypsiprymnus cuniculus*) is the largest of the rat kangaroos, measuring from tip of nose to root of tail about eighteen inches. It is a native of Tasmania. Gaimard's Rat Kangaroo (*H. gaimardi*) is a better known species, having become quite domesticated in the London Zoological Gardens, where it breeds freely. It inhabits both New South Wales and South Australia. The rat kangaroos, with slightly prehensile tails, form the genus Bettongia of Dr. Gray. These small creatures use their tail in helping to carry grasses wherewith to build their nests, which is placed in a hollow in the ground, and in which they pass the day, closing the entrance with a little fresh grass.

THE KANGAROO RAT (*Hypsiprymnus gaimardi*).

FAMILY LXXVI.—THE PHALANGERS (*Phalangistidæ*).

The Phalangers form an interesting group of marsupials, with a wonderful variety in the forms of the species. The hind feet are pentadactylous, with the big toe apart and clawless, and the two succeeding toes united as far as the claws. They are found over Australasia, and from New Guinea extend to the Moluccas and Celebes.

The Koala (*Phascolarctos cinereus*) is an animal about two feet in length, standing on all-fours. The limbs moderate and strong; the toes of the fore feet have the two innermost opposed to the outer three, and they hold most firmly to the branches of the trees in which they live. It rests during the day, but is active at night. The mother carries her young on her shoulders. It is found in East Australia.

The Woolly Phalangers belong to the genus Cuscus. About eight species are known, and these have the largest range of any of the family, being found from North Australia to the Celebes. They are vegetable eaters, of about the size of a cat, with a dense woolly fur, except the lower half of the tail, which is often naked and warty. They have large red eyes, seem slow and dull; can hold what they are about to eat in their fore paws, with which they clean their faces, licking the naked parts of their feet and tail with the lips and tongue. C. ursinus is from the Celebes; C. maculatus, New Guinea and Aru Islands; and C. ornatus has been collected by Mr. Wallace in Ternate. Dr. Gray makes eight species.

The Vulpine Phalanger (*Phalangista vulpina*) is about the size of a cat, and inhabits Australia. It is the commonest animal of this family in menageries, and has bred freely in the London Zoological Gardens. It feeds like a squirrel, and besides vegetable substances is known to eat birds. It uses its tail in climbing. P. fuliginosa (Ogilby) is found in Tasmania.

The Flying Phalanger (*Petaurista taguanoides*) is chiefly confined to the scrub districts of New South Wales. It has a short narrow head, broad ears, a long bushy tail; a membrane, covered with fur, stretches from the fore to the hind legs, being attached to the front leg as far forwards as the elbow joint, and in the hind leg as far as the inner toe.

THE KOALA (*Phascolarctos cinereus*).

The Flying Opossum (*Petaurus flaviventer*) is a native of New South Wales. It is, without including the tail, about a foot in length. It feeds on blossoms—the flowers of the various kind of gum-trees being its favourites. It seldom descends to the ground, but if chased it can perform most tremendous leaps.

The Short-headed Flying Opossum (*P. breceps*), with the same habitat, has bred in the

London Zoological Gardens, and can always be seen there, though it is mentioned by Mr. Waterhouse as being, when he wrote, rarely sent home.

The Opossum Mouse (*Acrobata pygmæa*) is about the size of a common mouse, and of an ashy-brown colour. It is said to be exceedingly numerous in the vicinity of Port Jackson.

The Dormouse Phalanger (*Dromicia nana*) puts one in mind of a fat dormouse. It is a native of Tasmania. It feeds on nuts, and other food of that kind, holding such in its fore paws. It is nocturnal, but is vivacious, running about, and making use of its little prehensile tail to ascend branches. It seems to hibernate during the winter months. Five species of this genus are known.

THE PHALANGER (*Petaurista tanguanoides*).

The Long-nosed Tarsipes (*Tarsipes rostratus*) is a little quadruped, of the size and general form of a mouse, but with a long, slender, and pointed muzzle. It is of a rich mouse colour, with three dark longitudinal stripes on the back. The feet are adapted for climbing; the toes have only small nails, which are embedded in the fleshy pads of the toes. These beautiful little animals are found from Swan River to King George's Sound, but are rare. One kept in captivity by Mr. Gould used to put out its long tongue, to suck the sugar, moistened with water, which he supplied it with. The edges of the tongue were slightly serrated, and it could protrude it for nearly an inch beyond the nose. In a state of nature it extracts the nectar from the blossoms, just after the fashion of a humming-bird.

THE WOMBAT (*Phascolomys wombat*).

FAMILY LXXVII.—PHASCOLOMYDÆ.

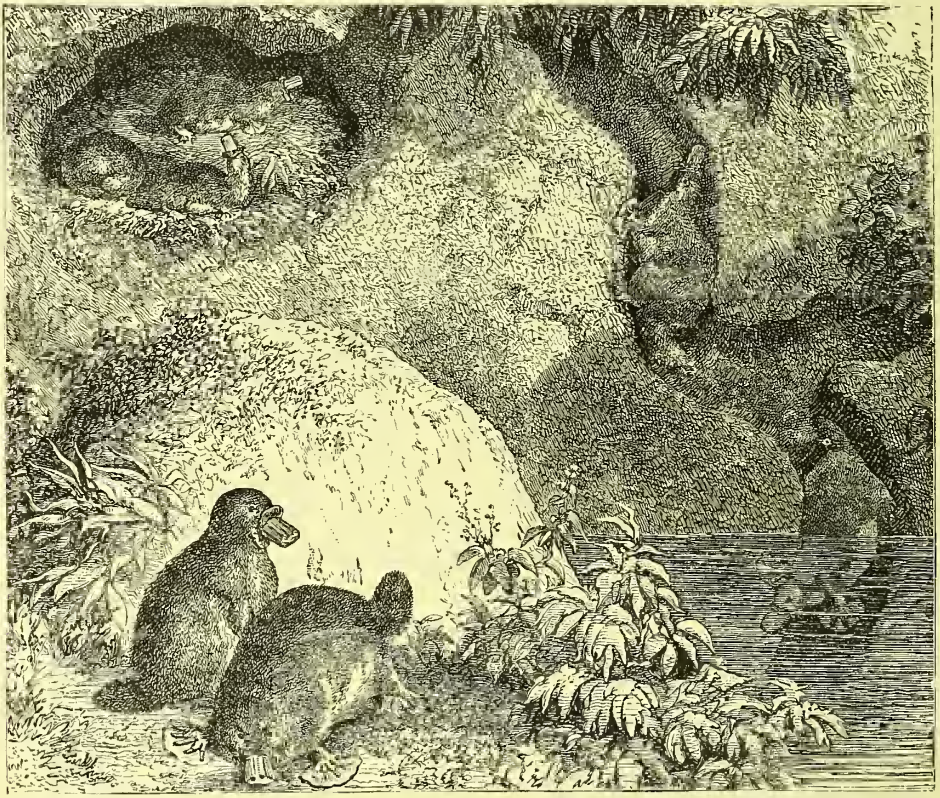
This family contains three species of small bear-like marsupials, found inhabiting Tasmania and South Australia. The Wombat (*Phascolomys wombat*) is a burrowing animal, nocturnal in its habits, feeding on roots and grass. It is often called the badger by the colonists. Mr. Bass's account would show that they are of a gentle disposition. The specimen described by Sir Everard Home lived as a domestic pet in Mr. Clift's house for two years, and allowed itself to be pulled about freely by children; and all the species have lived in the London Zoological Gardens. The other species are P. latifrons (Owen) and P. platyrhinus.

ORDER XIII.—MONOTREMATA.

This natural order contains three species that are among the lowest and most anomalous of the class Mammalia. They have no marsupial pouch. They possess only horny teeth. Although the females are furnished with true mammæ, yet the milk secreted by these glands is not collected into a nipple, and further the excretions of the alimentary canal and of the kidneys are discharged by a common orifice, as in birds, from whence the name of the order. Small as the order is, it must be divided into the following families :—

FAMILY LXXVIII.—ORNITHORHYNCHIDÆ.

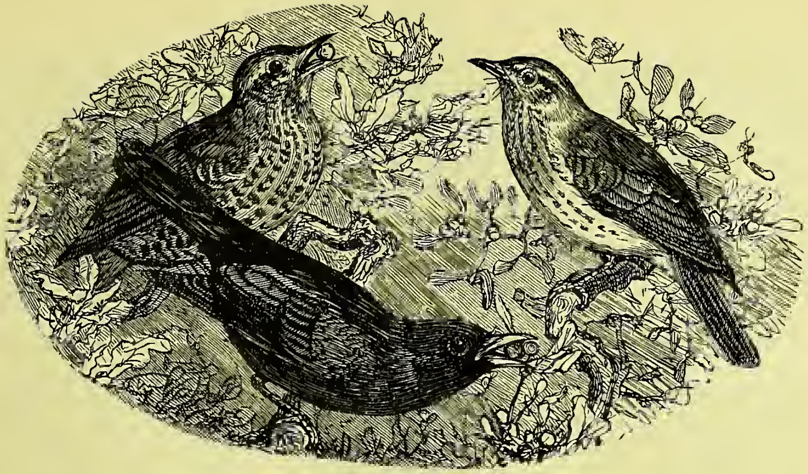
The Duck-billed Platypus (*Ornithorhynchus anatinus*), or the Water Mole of New Holland, is perhaps one of the most interesting and remarkable of mammals. It is found on the banks of rivers in Tasmania and South Australia, and feeds apparently on insects and small mollusca. The body is hairy, with a broad depressed tail; the feet are webbed; the head has a broad and depressed beak-like snout; eye small; jaws furnished with horny teeth, and long, narrow, horny appendages. The male has a spur to his hind foot.



THE DUCK-BILLED PLATYPUS (*Ornithorhynchus anatinus*).

FAMILY LXXIX.—ECHIDNIDÆ.

The Australian Hedgehog (*Echidna hystrix*) has a slender attenuated beak; the mouth opening is very small; tongue very long, exsertile; no teeth. Body furnished with spines and hairs intermixed; legs short and powerful, pentadactylous; toes with large nails; hind feet in male with a spur. It is an insect-feeding and ground-burrowing animal, about one foot in length, inhabiting New South Wales; is apparently stupid and apathetic, with immense powers of burrowing. A second species, E. setosa, is peculiar to Tasmania. In it the hair is so long as almost to hide the spines.



CLASS II.—BIRDS (*Aves*).

THE birds constitute the second class of the sub-kingdom Vertebrata. The following peculiarities will serve to distinguish them from all other vertebrates.

They are warm-blooded, oviparous (egg producing), and breathe by means of lungs. By warm-blooded, it is meant that the temperature of the blood of the animal remains at, or nearly at, a fixed degree of heat, independent of the medium (air or water) in which they live. In birds, the bronchial tubes open upon the surface of the lungs into sac-like dilatations. The anterior limbs (wings) are modified to serve as organs of flight, while the posterior (legs) are exclusively adapted for standing or running, and their integument (skin) is provided with certain horny appendages, called feathers.

It will not be necessary to dwell on the peculiarities of the various systems among the birds at the same length as was done in the case of the mammals, but we will call attention to a few of the chief peculiarities in each system.

THE TEGUMENTARY SYSTEM is not only well developed in birds, but the peculiar appendages to it, called feathers, are characteristic of the class, and to them birds owe all their often great beauty. With the exception of the beak, the legs, and, in a few birds, of some parts of their neck and head, the whole body of an adult bird is covered with feathers. In some birds, no sooner have they come out of the shell than we find them covered with down, though others are hatched out in a more or less naked or downless condition. In this respect there is a great contrast between a young duck and a young pigeon. Passing by, with but a bare allusion, the different forms of horny investment met with in the bills of birds—the hindermost part of which is often soft and large, when it is called the cere, in which sometimes the nostrils are placed, and which is sometimes elongated into a loose pendulous caruncle (turkey), or into the wattles met with in some of the scraping birds, or forms the horny helmets of the cassowaries—also the forms of the tarsal scales, sometimes, as in the chauna and the ostrich, presenting the appearance of hexagonal horny scales, and in some birds becoming elongated and spur-like—we must investigate the structure of the feathers. We should distinguish between pen feathers (pennæ) and down feathers (plumulæ): the former have a perfect quill, with branches and rays; the latter have no quill, and the rays want the little hooklets which will be found in the former. A third form is met with in a few birds, where they are hair-like (filoplumæ) from a further development of the base. The pen feathers are mostly placed in definite regions, and between these there are either naked spaces or regions furnished with down feathers; and the reader anxious to follow up this subject should consult Nitzsch's "System der Pterylographie," translated and edited by Dr. Sclater. Those of most importance, from a classificatory point of view, are the feathers that either effect flight, or guide and steady the bird while flying, namely, those of the wings and the tail. The flying feathers (remiges) are large pennæ, of which nine to eleven are inserted on the hand: these are the primary wing feathers; another series, the number of which varies greatly, is inserted on the fore-arm (ulnar bone): these are the secondary wing feathers (a few stiff feathers are to be found on the first finger, and sometimes a horny claw takes their place). The great tail feathers (rectrices), as well as the great wing feathers, are covered over by smaller feathers, called wing coverts and tail coverts, but sometimes these far surpass in size the feathers they act as coverts to; thus, in the peacock, the tail coverts are many times longer than the rectrices, and thus the so-called peacock's tail is really no tail at all; the gracefully curved feathers, too, in the tail of the domestic cock and in some trogons, are tail coverts, and so are the coveted plumes of the ostrich. In the apteryx, the cassowaries, and the ostriches, the wings are altogether concealed under the coverts. Birds moult their feathers usually about the beginning of autumn, after the nesting season is over.

Professor Huxley tells us "that the external surface of the dermal papilla, whence a feather is to be developed, is provided upon its dorsal surface with a median groove, which becomes shallower towards the apex of the papilla. From this median groove lateral furrows proceed at an open angle, and passing round upon the under surface of the papilla, become shallower, until, in the middle line, opposite the dorsal median groove, they become obsolete. Minor grooves run at right angles to the lateral furrows. Hence the surface of the papilla has the character of a kind of mould; and if it were repeatedly dipped in such a substance as a solution of gelatine, and withdrawn to cool, until its whole surface was covered with an even coat of that substance, it is clear that the gelatinous coat would be thickest at the basal or anterior end of the median groove, at the median ends of the lateral furrows, and at those ends of the minor grooves which open into them; while it would be very thin at the apices of the median and lateral grooves, and between the ends of the minor grooves. If, therefore, the hollow cone of gelatine, removed from its mould, were stretched from within, or if its thinnest parts became weak by drying, it would tend to give way, along the inferior median line, opposite the rod-like cast of the median groove, and between the ends of the casts of the lateral furrows, as well as between each of the minor grooves, and the hollow cone would expand into a flat feather-like structure with a median shaft, as a "vane" formed of "barbs" and "barbules." In point of fact, in the development of a feather, such a cast of the dermal papilla is formed, though not in gelatine, but in the horny epidermic layer developed upon the mould, and, as this is thrust outwards, it opens out in the manner just described. After a certain period of growth the papilla of the feather ceases to be grooved, and a continuous horny cylinder is formed, which constitutes the quill."

Some downy feathers have the shaft never fully formed, and secrete a powdery-like substance. Such feathers occur in the herons, in some parrots, and in many birds of prey.

THE OSSEOUS SYSTEM.—While a few of the bones of the bird skeleton are filled with marrow, others are filled with air, as will be seen when we come to the subject of respiration. The skull is articulated to the first cervical vertebra by means of a single condyle. The neck and tail vertebræ are alone capable of motion, those of the back being anchylosed together. The neck vertebræ vary from nine to twenty-three. The tail vertebræ form the smallest portion of the column, and vary from seven to eight; the last is not hollow, is generally flattened, and supports the tail feathers. The dorsal vertebræ are provided with movable ribs; in number they are usually less than those of the neck. The lumbar and sacral, usually from ten to fourteen, lie between the side bones (ossa innominata), and are anchylosed together. The two or three anterior ribs (regarded by Owen as cervical) are not attached to the breast-bone (sternum); the others are attached by means of bony pieces (sternal ribs). There is usually a long piece, which mounts obliquely upwards over the rib above it, attached to the ribs; sometimes this remains separate. With a rare exception the breast-bone is large, covers not only the chest, but also part of the abdominal cavity: it is for the most part deeply keeled in front; the wing-bones are connected to the breast-bone; the collar-bones (os furculare) run downwards and backwards, meeting in front, and coalescing. Sometimes these are attached to the sternum, either by bony, cartilaginous, or ligamentous union; they are often fully developed, and sometimes wanting. The coracoid clavicles are never absent; they are flatter and shorter, and attached to the uppermost part of the breast-bone, helping to form, with the long thin shoulder-blade, an articular surface for the big wing-bone (humerus): this is cylindrical, and varies immensely in length, being very long in the pelican and very short in the penguin. To the big wing-bone succeed the two bones of the fore wing (ulna, radius); the wrist is formed by two short little bones, at its anterior margin, to which the one or two joints of the thumb are attached; then come the two hollow metacarpal bones, coalesced above and below; and there are at the lower end of these the two digits, of which the outer is small, and the inner is often very long, and is composed of two or three joints. The anterior limbs are never absent, though sometimes quite rudimentary. In the pelvic region, we find that, except in the ostrich, the pubic portion of the ossa innominata are never connected with each other. The thigh-bone (femur) is shorter and thicker than the tibia; close to the latter lies the imperfect fibula, which never extends quite to the tarsus; a knee-bone is almost always present. Sometimes in water-birds the tibia terminates in a triangular bony process. The tarsal and metatarsal bones are anchylosed into one mass called the tarso metatarsus. Most birds have four toes, three anterior, one posterior; this last is often wanting, and the feet of the African ostrich are two-toed.

Each side (ramus) of the lower jaw is composed of several pieces, and is connected to the skull by a remarkable (quadrate) bone, the outermost arm of which is connected by an articulation with the temporal bone. The jaws of birds have no teeth, and are covered with a horny fibrous investment, very hard in some birds, as the parrots, soft, and endowed with great sensibility in some, as the ducks.

THE ALIMENTARY SYSTEM.—Most birds have salivary glands, but none of them masticate their food; this, at one gulp, passes into the œsophagus, which in some birds is sac-like, and known as the crop; it lies generally on the right side of the neck; in the pigeon two such sacs are found behind the crop; the œsophagus narrows and passes into the stomach; this consists of two divisions: the first, the glandular stomach, where the gastric juice is secreted, with which the food being well mixed, it is forwarded into the second division; which is muscular, and well known as the gizzard. This is well developed in gallinaceous fowl, and soon grinds and triturates the food, which then passes into the pyloris (here in a few birds there is a third stomach); the contents of the gall bladder and of the pancreas meet it here, when all pass to the intestines; these, in proportion to the length of the body, are shorter than in mammals. Where the large intestine begins, two cæca are commonly found; in the heron there is but one, and in some birds, as the parrots, both are wanting. The rectum opens into the cloaca, into which the ureters open, and in the female also the ducts which carry the eggs.

The liver is large, and generally deeply divided into two lobes. Tiedemann says, that in some birds it equals in weight the one-twentieth of the whole body, in the peewit it is one-thirteenth, and in one of the mergansers one-tenth of the weight of the body. It can be artificially increased in size, as in the well-known case of the Strasburg geese.

THE BLOOD SYSTEM.—The heart does not differ in any very essential particular from that in the mammals. It rests on the sternum, has an elongated conical form; the apex of the heart is formed by the left ventricle, and has much thicker walls than the right ventricle.

The lungs, two in number, lie upon the dorsal surface of the thoracic cavity, and are not divided into lobes; the two bronchi open on the surface of the lungs; the larger tubes passing into air sacs which are in connection with the lungs; the smaller bronchial tubes form, by anastomoses, a regular network of tubes, along the walls of which are the capillaries, in which the oxidation of the blood takes place. Through the apertures of the bronchial tubes on the surface of the lungs the air also passes into a series of air sacs, which are partly in the thoracic and partly in the abdominal cavity, and these convey air to the hollow bones. These are usually the arm-bone, the breast-bone, and some of the head-bones; often also, the vertebræ (never the first cervical), the ribs, the pelvic and thigh-bones. In the hornbills even the toe-bones are pneumatic, while in the apteryx, the lower jaw is the only portion in which there is any trace of pneumaticity.

Considering the vocal organs in connection with the organs for respiration, we find that the windpipe differs from that of mammals, in that it is not the upper portion (larynx) which produces the voice of the bird, but the inferior portion where it divides into the bronchi (inferior larynx), and the organ for the production of sound occupies a part of each bronchus, and so is double. The bronchial rings are generally incomplete, but the windpipe rings are perfectly closed and sometimes coalesce. Where the range of the musical scale is large, the rings are thin, and the membranous interspaces broad, thus allowing of a considerable shortening and lengthening of the windpipe, so that the sound produced in the inferior larynx becomes mollified as it is conducted along the windpipe and superior larynx. The superior larynx is situated under the base of the tongue. It consists of ossified cartilages, of which the largest is in front, where it is deepest and annular, and not completely closed behind. The posterior part carries the cricoid cartilage.

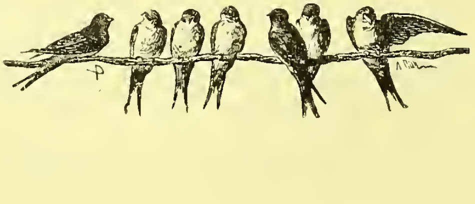
Birds are strictly oviparous, that is, they produce eggs from which the young birds are hatched. The development of the young bird proceeds, as is well known, by means of brooding after the egg has been laid. The warmth requisite for the development of the chick in the egg is about 100° Fahrenheit; in a somewhat lower temperature the development still proceeds, but more slowly; a low temperature causes the death of the chick. Since the eggs that lie directly under the breast of the hen bird are, necessarily, exposed to a greater heat than those placed at the edge of the nest, the bird moves the eggs after a time, and places those in the middle at the edge, and conversely, so that the development of the whole may proceed uniformly. The duration of incubation varies, being twelve days for some of the humming-birds, twenty-one days for the common fowl, twenty-five for the ducks and cormorants, twenty-seven for the turkey, twenty-nine for the geese, thirty-one for the pea-fowl, forty-two for the swans, and sixty-five for the New Holland cassowary.

The eggs of birds vary in size, and are variously tinted and mottled, and, though not in every instance, yet in many, we can certainly see an adaptation of the colours to the purposes of concealment, according to the habits of the various classes of birds. Thus, as a general rule, the eggs of birds which build their nests in dark holes, or which construct nests that almost completely exclude the light, are white; as is also the case with those birds that constantly sit on their eggs, or leave them only for a short time during the night. Eggs of a light-blue or light-green tint will also be found in nests that are otherwise well concealed; while, on the other hand, a great proportion of those nests which are in exposed situations have eggs varying in tints and spots which in a remarkable degree correspond with the colours of the external objects in their immediate neighbourhood. Thus, a dull green colour is common in most gallinaceous birds that form their nests in grass, and in aquatic birds-nesting among green sedges; a brighter green colour is prevalent among birds that nestle among trees and bushes; and a brown-mottled colour is found in those eggs that are deposited among furze, heath, shingle, and grey rocks and stones.

The intensity of the instinct of hatching is well known; it even diverts the animal from one of the strongest instincts—the pursuit of food; it is a care added to that of nest-building, both tending to the same end. The exception familiar to us is the cuckoo; and of this anomaly no adequate solution has been offered, since this bird remains with us long enough to rear its own offspring. Yet, even that exception has its interest, as the mode adopted is equally efficacious for its designed end.

The Class *Aves* may be divided into ten orders:—

1. Passeres	Perching-Birds.
2. Picariæ	Scansores, Climbers. Fissirostres, Gapers.
3. Psittacini	Parrots.
4. Columbæ	Doves.
5. Gallinæ	Scrapers.
6. Opisthocomi	The Hoazin.
7. Accipitres	Birds of Prey.
8. Grallatores	Waders.
9. Anseres	Swimmers.
10. Struthiones	Ostriches.



ORDER I.—THE PERCHING-BIRDS (*Passeres*).

This order is the most extensive among the birds. It contains nearly 5,800 species, arranged in no less than 870 genera. It was originally established by Linnæus as his sixth order. He placed in it those birds having a "rostrum conicum, acuminatum," with the "Nares ovatæ, patulæ, nudæ," and it contained the pigeons, larks, starlings, thrushes, finches, buntings, sparrows, wagtails, tits, swallows, and goat-suckers.

Cuvier divided it into five sub-orders:—1. The Dentirostres—perching-birds with a stout conical bill, the upper mandible toothed, and usually more or less hooked at the tip; feeding principally on insects and fruits (the shrikes). 2. The Fissirostres, where the bill is more or less depressed, and opens with a very wide gape; the birds mostly feeding on insects, which they frequently capture on the wing (the swallows and goat-suckers). 3. The Conirostres, birds with a stout conical bill, but the upper mandible not toothed, or very indistinctly so; feeding on hard seeds (the house sparrow). 4. The Tenuirostres, with an elongated and awl-shaped bill; the birds feeding on the larval forms of insects, often on the nectar of flowers (as the sun-birds and the humming-birds). 5th. The Syndactyla. In this sub-order, which Cuvier regarded as equal to a second division of the whole order, were placed some few genera of perching-birds, in which the two lateral toes were more or less united to the middle toe; and here were the bee-eaters, kingfishers, todies, and hornbills.

Vigors, Swainson, and G. R. Gray, introduced various modifications of this arrangement, but to this very time ornithologists do not seem at all agreed as to what is a natural arrangement of this difficult group: "which is one," writes Mr. Wallace, "comprising at once the most perfect, the most beautiful, and the most familiar of birds. The feathered inhabitants of our fields, gardens, hedgerows, and houses belong to it. They cheer us with their song, and delight us with their varied colours. Their activity and elegant motions are constant sources of pleasure to every lover of nature. They are the birds with which, from our infancy and boyhood, we are most familiar, and we, therefore, involuntarily derive from them that ideal or typical form of animal life with which we connect the general term bird. And thus doing, who can doubt but that we are correct? The lightness, activity, elegant forms, brilliant colour, and harmonious voice by which birds as a whole are peculiarly distinguished from all other animals, find in this group their fullest expression and most complete development. Here, too, the greatest variety of forms and habits is found, which are all connected together by such insensible gradations, that to discover in every case their true affinities has ever been and still remains one of the most difficult, and, at the same time, most interesting problems the naturalist has to solve."

In these pages we follow Mr. Wallace's classification, which commends itself to us as being based on an extensive knowledge of the manners and habits of birds—a knowledge acquired during many years' travel in various parts of the world, as well as on a knowledge of their structure. He divides the Passeres into five series:—1. The thrushes; 2. The tanagers; 3. The starlings; 4. The ant-eaters; and 5. Such anomalous passeres as the lyre-bird and scrub-bird of Australia. These five series will contain about fifty families, only a tithe of which we can allude to. We commence with the first series, that of

THE THRUSH-LIKE PERCHING BIRDS.

The species belonging to this group are nearly 2,600 in number, or about one-half of all the known perching-birds, and among this number are our most melodious song-birds; and were we to write the full history of these only, we should far exceed the space at our disposal. Just glancing at some of the more remarkable families, and mentioning some of the best known birds occurring in these, must suffice. Of the first family, Turdidæ, or Thrushes, the most familiar bird is the Thrush (*Turdus musicus*). It is indigenous to our island, and remains with us throughout the year. In winter its numbers are increased by arrivals from the more northern parts of Europe. In England the thrush is considered only as an early songster, beginning its melody at earliest by end of January, and continuing it until July. But in Ireland, where the winters are milder, its song, even in the north, is continued in fine weather throughout the year, excepting at the moulting period, and, as if the bird felt the winter day too brief, its melody does not cease when the sun goes down.

This bird breeds early; sometimes in the month of March, and not uncommonly before the middle of April, incubation has commenced. The favourite sites chosen for the nests are evergreen shrubs, young trees, and beech hedges, yet, even where these abound, the thrush not unfrequently prefers placing it in the holes of walls and beneath the roof of sheds. The thrush has commonly a second brood. Several memoranda are before me of young birds being unfledged late in August, and on one occasion the young were unable to leave the nest before the 1st of October.

Although thrushes are very destructive to our cherries and other fruits, the admiration in which their song is held generally pleads so strongly in their favour as to save them from destruction. By several British authors, Helix nemoralis is particularised as a favourite repast with this species, to which one author adds the H. hortensis, and another the H. lucida; but its predilection for such food is far from being limited to these species. The beautiful Helix arbustorum, whose delicate shell is much more easily broken than that of the others, is an especial favourite. So eagerly is it sought for by the thrush (and probably also by the blackbird), that in some localities in which the fragments of broken shells first announced to me its contiguity, I have found it difficult to obtain specimens after the successful foraging of the birds.

THE THRUSH (*Turdus musicus*).

The Fieldfare (*T. pilaris*) is a regular winter visitant, appearing generally in the north towards the end of October or beginning of November. In 1840, they did not arrive at the Falls, near Belfast, until the 9th of November, on the morning of which day a flock was seen there by William Sinclaire, Esq., at a very great height in the air, coming from a north-easterly direction. This gentleman is of opinion that in the course of the preceding moonlight night they may have come in one flight direct from Norway. Mr. Macgillivray mentions its appearing in the northern and eastern part of Britain at the end of October or beginning of November. Sir William Jardine, writing from Dumfriesshire, remarks that its time of arrival is late in November. This bird remains until a late period in spring. Mr. Hewitson remarks:—"The fieldfare is the most abundant bird in Norway, and is generally diffused over that part of the country which we visited, from Drontheim to the Arctic Circle. It builds in society. Two hundred nests or upwards may be found within a small circuit of the forest. Nothing is said of its song. The fieldfare only arrives in Provence when the cold is excessive at the beginning of winter. It stays in the wildest places, and departs at the approach of spring. It does not cross the Mediterranean Sea."

The Redwing (*T. iliacus*) is a regular winter visitant, its migration, like that of the fieldfare, extending over the island. In the north, it generally arrives about the middle of October, sometimes early in the month, and remains until the beginning or middle of April; to the end of this month its departure was delayed in the very late spring of 1837. In the severe winter of 1813, these birds were so reduced about the south of Ireland, that several of both species were killed with a stick thrown from the hand. In the north, that winter was remarkably fatal to birds generally. I have never met with redwings roosting on the ground like fieldfares, but, instead, in hedgerows and thick plantations. A favourite locality in which they, in different years, came under my observation, was a dense plantation of larch-firs of about fifteen years' growth, on a hill-side, where their concerts, like those of grey linnets, before going to roost, were most agreeable. But in the morning, and forenoon likewise, during fine weather, chiefly towards the spring, a flock of redwings from a hedge or plantation will sometimes delight us with a most agreeable concert, and a single bird will occasionally utter a few melodious notes. Mr. Hewitson remarks:—"In our long rambles through the boundless forest scenery of Norway, or during our visits to some of its thousand isles, whether by night or by day, the loud, wild, and most delicious song of the redwing seldom failed to cheer us." The same author informs us that "the nest of the redwing is placed, like those of the thrush and blackbird, in the centre of a thorn or other thick bush."

The Missel Thrush (*T. viscivorus*) is a native of our islands and the Continent of Europe. This bird is closely allied to the song thrush, exceeding it in size, but greatly inferior to it in melody and richness of voice. It is also much rarer, though in some districts, as Northumberland, and particularly in the southern counties of Ireland, it is on the increase. It is a bold, pugnacious bird, and perched on the top of a tree will pour forth its melancholy, yet musical cadences, even amidst the cold and winds of February. "In general," says White, "it is very successful in the defence of its family; but once I observed in my garden that several magpies came determined to storm the nest of a missel thrush. The dams defended their mansion with great vigour, and fought resolutely; but numbers at last prevailed. They tore the nest to pieces, and swallowed the young alive." This bird derives its name from the mistletoe, of the berries of which it is very fond; its other food consists of slugs, worms, and insects. The nest is generally placed in the fork of a tree. It appears outwardly a mass of coarse stems of plants, moss, withered grasses, and lichens, but within it is stuccoed with mud and clay, which is again lined with delicate grasses. Here are laid four or five eggs, generally of a greenish-white, spotted with ruddy brown, but the colour occasionally varies to pinkish or reddish-white, mottled with dark red-brown hues. The missel thrush is apt to avail itself of any suitable materials in building its nest. In one instance, a lady lost a lace cap in spring; in autumn, when the leaves began to fall, something white appeared in one of the trees, and, on inspection, proved to be the cap, that had been used by one of these birds in constructing its nest. In another case, a smaller offence was committed: a narrow piece of net, a yard in length, having been carried off when bleaching, was afterwards found composing part of the nest of the missel thrush.

THE BLACKBIRD (*T. merula*).

The Blackbird (*T. merula*). Those who live in the country, and who are apt to wake early on spring mornings, when all around is still, and the lark itself is yet on the ground, must often have been charmed with the solitary song of the blackbird, a brief stave of six or seven notes only, followed by an interlude of silence, during which the ear listens eagerly for its repetition. This warbler loves to hide itself in "darkling covert," and there, shrouded among foliage, to pour forth its songs. It frequents shrubberies, large gardens, and the borders of the woods. A bower of ivy, a thick laurel hedge, or a solitary bush of some luxuriant evergreen, is a favourite site for its nest. It often builds close to the house, and in places where it is constantly passed and re-passed, as near a garden walk. It has been seen in the laurel hedge, bordering the play-ground of a ladies' school, and though the inmates often took a peep at "the pretty birds," yet they there brought up their brood. The blackbird is more recluse than the thrush, and more suddenly flits, when disturbed, to its covert. The nest, formed of fibres, moss, and small twigs, is lined with mud, over which is spread a layer of fine dry grass. There are four or five eggs, of a fine bluish-green, with spots of pale reddish-brown. Sometimes they are of an uniform blue, without spots.

The blackbird is distributed generally through the British islands. It is found also in Wales, and in Ireland and Scotland, where it inhabits the Hebrides, Orkney, and Shetland. Blackbirds are entitled to an honourable place among birds for displaying affection towards each other in a remarkable degree. The male and female are constantly seen together in winter, and it is believed, says Mr. Morris, that they frequently pair for life. The care that they evince for their young while in the nest is most touching. An accurate observer told Mr. Macgillivray that, having watched a pair of blackbirds, who had a nest with four young ones in it, from a quarter-past three in the morning till a quarter before nine at night, he found that during that period the male fed the young forty-four times, and the female sixty-nine times !

The blackbird is a capital imitator, and it is the opinion of some that he is nothing else than a mocking-bird, who borrows his notes from his neighbours, and turns them to his own account. There is a curious instance on record of his having been heard, says Mr. Morris, crowing like a cock, even in the wild state ; and when the cocks in the neighbouring farm-yard answered his challenge he seemed delighted, and even flapped his wings when he crowed, to keep up the mimic rivalry. One has successfully imitated the song of the nightingale ; another, the cawing of a crow ; and another attempted the chuckling of a hen. The male bird is of an uniform deep black over the whole body, with the legs and claws of a dusky-brown. The bill, the eyelids, and the mouth are of a bright orange. The female has all the plumage of the upper surface of an umber-brown ; the chin, throat, and upper part of the breast are reddish-yellow-brown, with a few darker spots ; the belly, sides, and under tail-covert are hair-brown. It is not uncommon to meet with varieties more or less pied with white.

In the spring, summer, and autumn, says the Rev. F. O. Morris, the blackbird feeds on moths, beetles, and other insects and their larvæ, worms, snails, fruits, and seeds, such as cherries, currants, gooseberries, peas, and pears ; their place being supplied in winter by wheat, oats, and other grain and seeds, and the berries of the hawthorn, mountain-ash, holly, and others. It sometimes does some damage by pulling up plants in search of insects. The shells of snails it breaks against any hard spot, as the thrush does. In the autumn it frequents turnip-fields in search of insect food. Doubtless, as in so many similar cases, the evil that it may do is counterbalanced by a proportionate amount of good.

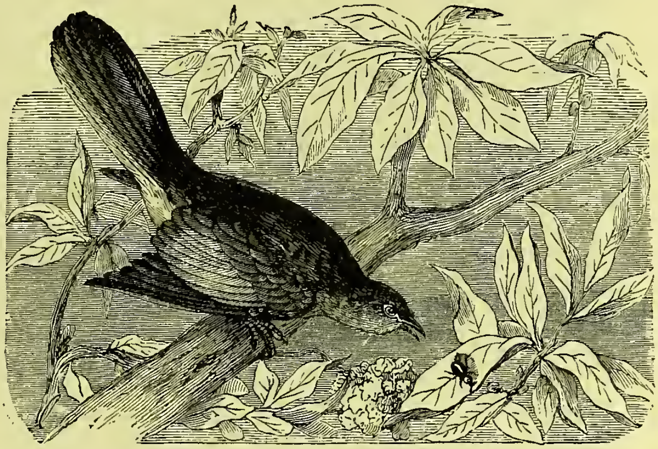
The Ring-Ouzel (*T. torquatus*) is found during summer in suitable localities over our islands. From the south to the north of Ireland, the ring-ouzel is a summer inhabitant of certain haunts, which wholly differ in their character from those frequented by the other British thrushes, and render it little known, except to the student of nature, or to the visitor of the wild and rocky mountain scenery. "To my ear," says Thompson, "its call-note is extremely pleasing, from association in the mind with the free spirit of nature, with localities which own not—and never will own—man's dominion. The ring-ouzel is truly a "tenant of the wild." It first became familiar to me in the glens or ravines cleft in the range of mountains lying westward of Belfast, every one of which, that displayed wild romantic beauty in an eminent degree, boasted its pair or more of these birds, whose haunts were always where the cliffs or banks were loftiest, and where the cascade formed a picturesque accompaniment to the scene. Within the distance of five or six miles were as many of these localities thus resorted to, and where only, throughout the district, the birds were to be found, except at the periods of their migratory movements."

On the Continent the ring-ouzel is always seen early in the spring. It has been observed towards the end of February ; on one occasion it was seen as late as the 15th of April. The cold of November brings it back regularly. None remain during winter, not even on the shores of the Mediterranean or in the neighbouring islands ; so that among all the birds of this tribe, which are sent from Corsica every winter to Toulon and Marseilles by thousands, not one ring-ouzel is to be found before the end of February.

The Mocking Bird (*Mimus polyglottus*). According to Wilson, the ease, elegance, and rapidity of the movements of this American bird, the animation of his eye, and the intelligence he displays in listening, and laying up lessons from almost every species of bird within his hearing, are truly astonishing, and indicate the peculiarity of his genius.

His voice—full, strong, and musical—is capable of almost every modulation, from the clear mellow tones of the wood thrush, to the savage scream of the bold eagle. In measure and accent he faithfully follows his originals, but he greatly surpasses them in sweetness and force of expression. Mounted on the top of a tall bush or low-growing tree, in the dawn of a dewy morning, he exceeds every competitor, though the woods are vocal with a multitude of warblers. It is as if he sang alone, and the music of others were a mere accompaniment.

Not that his strain is altogether imitative. He has native notes, easily distinguishable by those who are well acquainted with the songs of birds—bold, full, and exceedingly varied. They consist of short expressions, of two, three, or, at the most, five or six syllables, generally interspersed with imitations, all of them uttered with great emphasis and rapidity, and continued with undiminished ardour, for half an hour or an hour at a time; his expanded wings and tail, glistening with white, and the buoyant gaiety of his action, arresting the eye, as his song irresistibly does the ear. Sweeping round with enthusiastic ecstacy, he mounts far aloft, and descends as his song swells or dies away. A bystander, with closed eyes, might suppose that the feathered tribes were engaged in a trial of skill, each aiming at the utmost effect, so perfect are his imitations. Often does he deceive the sportsman, sending him away in chase of birds not perhaps within miles of him, but whose notes he exactly imitates. Even birds are frequently imposed on by this extraordinary mimic, and are decoyed by the fancied calls of their mates, or hastily dive into thickets, alarmed at what they suppose to be the scream of the sparrow-hawk.



THE MOCKING-BIRD (*Mimus polyglottus*).

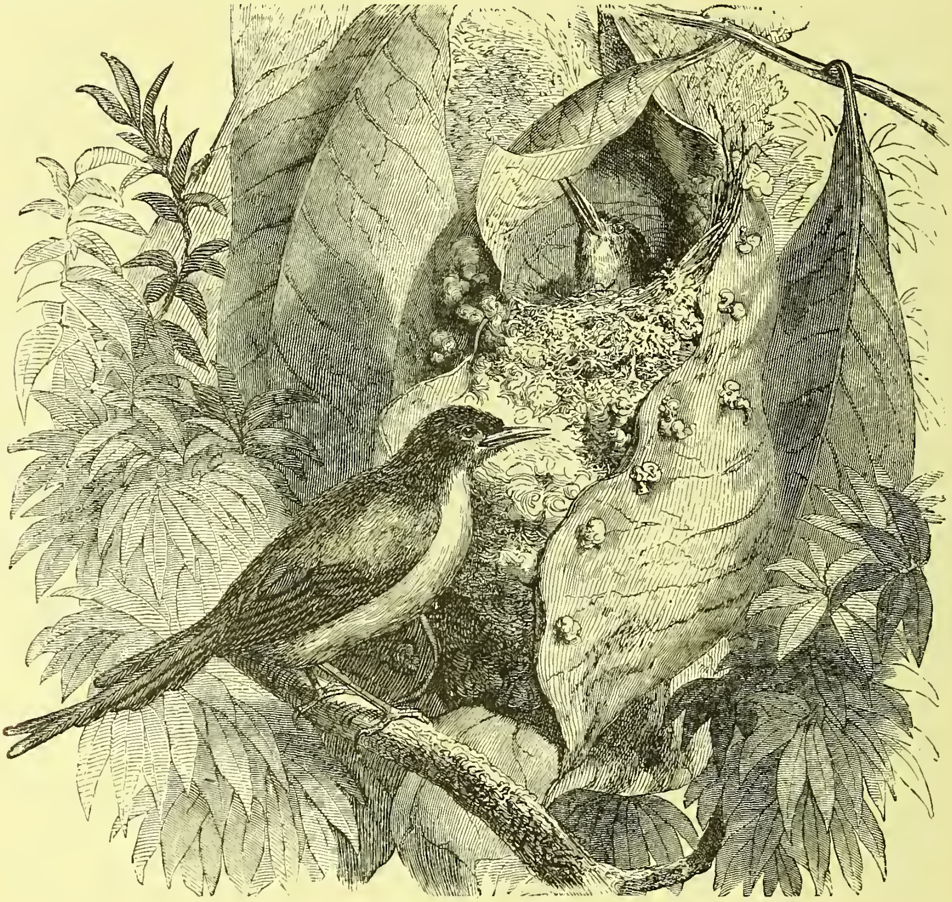
The exact time at which this bird begins to build depends on the latitude in which it is found. Great discretion is always displayed in selecting a spot for its nest: a solitary thorn-bush, an almost impenetrable thicket, an orange-tree, a cedar or holly-bush, being preferred; but if any of these cannot be obtained, except within a short distance from a house, it does not hesitate to build there, often choosing an apple or a pear-tree. The nests vary with the materials that may be within reach. A very complete one is described by Wilson, as consisting, first, of a quantity of dry twigs and sticks, then withered tops of weeds of the preceding year, intermixed with fine straws, hay, pieces of wool and tow, and lined with a thick layer of fibrous roots, of a light brown colour.

The eggs are of an ashy blue, marked with large patches of brown, and there are sometimes four or five. The female usually produces two broods in a season, and if robbed of her eggs, will even build and lay a third time, though she is apt to forsake the nest if disturbed.

The WARBLERS (*Sylviadæ*), by far the largest family of the whole group, contains the Tailor Bird (*Orthotomus longicaudus*). It is not more conspicuous than a common sparrow, and is chiefly remarkable for its curious nest, which is made in a singular and most ingenious manner. Taking two leaves at the extremity of a slender twig, the bird literally sews them together at their edges, its bill taking the place of a needle, and vegetable fibres constituting the thread. A quantity of soft cottony down is then pushed between the leaves, and a convenient hollow scraped out in which the eggs may lie and the young birds may rest at their ease. Sometimes, if the leaf be large enough, its two edges are drawn together, but in general a pair of leaves are needed; a few feathers are sometimes mixed with the down.

This curious nest is hung at the very extremity of the twigs, evidently in order to keep it out of the way of the monkeys, snakes, and other enemies, which might otherwise attack and devour mother and young together.

The Willow Wren (*Phylloscopus trochilus*) visits our island about the beginning of April, and leaves it in September. It is an admirable songster, uttering a clear, loud, piercing strain, which may be heard in the woods and groves of every part of our island, excepting Cornwall and the west of Devonshire. Very animated are its actions, and it catches insects on the wing with great address. In May it builds an oval nest, composed of grasses, mosses, and dried leaves, lined with feathers, and with a small opening at the top. The eggs are six or seven, white, with reddish-brown spots, numerous at the larger end. The plumage of the upper surface of the willow wren is of a greenish yellow-brown; the under parts are white, tinged with yellow, especially on the cheeks, throat, and under tail-coverts; an obscure streak of yellow runs over each eye.



THE TAILOR BIRD (*Orthotomus longicaudus*).

The Golden-crested Wren (*Regulus cristatus*) is not merely the smallest but one of the most beautiful of British birds, and yet, though abounding in most places, its active and restless habits and the silence of its movements lead to its being but little noticed. The oak, the yew, and the various species of the fir and pine, are the usual haunts of the golden-crested wren. In these tall trees it builds its nest, not merely neatly but elegantly, the shape varying according to the situation in which it is placed. It is generally like that of the chaffinch, open at the top, but sometimes, even under the sheltering boughs of a Norway fir, it is covered with a dome, and has an opening on one side. It is always ingeniously suspended beneath the branch, like those of many tropical birds, and is the only instance of the kind among our birds. The eggs—small, round, and cream-coloured—are nine or ten in number.

It is not a shy bird. Though it abounds in forests, it equally frequents gardens, occasionally even the suburbs of large towns, and very often builds close to the house. It will visit the plants trained round windows; and has been known, when pursued by a hawk, to seek refuge in a room where people were sitting, and alight on the top of the bell-rope, whence it suffered itself to be taken by the hand.

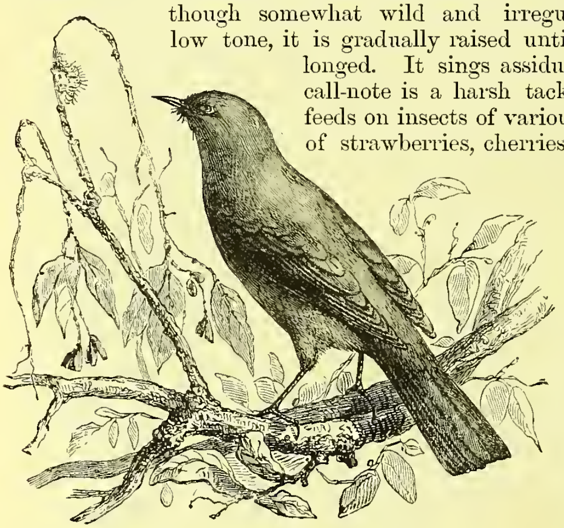
THE GOLDEN-CRESTED WREN (*Regulus cristatus*).

This bird remains with us all the year round. During the greater part of it it never alights on the earth; but in the winter it is often seen pecking for insects in the grass, or among dead leaves, and even on heaths at some little distance from any tree; and when thus engaged it may be approached sufficiently near for the observer to hear the snap of its little beak in seizing its prey.

In the spring and summer it sings regularly, beginning about the middle of March, and continuing till the end of July. Its song is very soft and low, like a whisper. Perhaps the best time for watching it is a hot sunny day in summer or autumn. Pleasant, indeed, are its shape and plumage, surpassing, as they do, those of most of the feathered inhabitants of our woods and gardens. The plumage is a beautiful mixture of green and yellow, with white bars on its wings; and on its head is the golden crest. bordered with black, from which it takes its name.

Of the species belonging to the genus Sylvia we have the Chiff-chaff (*Sylvia rufa*), which is a regular summer visitant to certain localities from south to north. It differs from the willow wren in being very partially, instead of generally, distributed; its well-known notes, resembling chiff-chaff, cherry-churry, are among the first signs of spring.

The Garden Warbler (*S. salicaria*). Its range is somewhat restricted; for it does not appear to inhabit Asia east of the Ural, though in Europe it is generally distributed during the summer season up to 69° N. lat., retiring southward for the winter, at which season it penetrates tolerably far to the south in Africa. It assimilates closely in habits to the black-cap, frequenting woodlands where the undergrowth of weeds and brambles is dense, and gardens where there is good shelter, and where it is undisturbed. Though restless and active in its movements, seldom remaining long in one place, it is very secretive in its general habits, and is not a bird one often sees, unless one knows just where to look for it, and follows or watches for it carefully. With us in England, as elsewhere in Northern and Central Europe, it is a summer migrant, arriving late in April or early in May, when the trees are bursting out into leaf; and, as is the case with most if not all of our summer visitants, the males arrive before the females. Its song is sweet, though somewhat wild and irregular; and though commenced in a low tone, it is gradually raised until it becomes loud, and is usually prolonged. It sings assiduously throughout the whole day. Its call-note is a harsh tack, tack, tack, rather deep in tone. It feeds on insects of various kinds, berries, and fruit, and is fond of strawberries, cherries, plums, and other garden fruits; and in the south of Europe it is said to be very partial to figs: hence its Italian name "Beccafico," for, so far as I could ascertain, the present species is the true "Beccafico," though I saw numbers of various kinds of small birds, including even titmice and greenfinches, sold in the Italian markets under that name. Herbert says that it feeds on the berries of the ivy, privet, elder, and berberry; and Sweet that it is exceedingly partial to the larvæ and caterpillar of the common cabbage-butterfly; and it is said, he adds, the only bird of the genus known to him that will feed on this destructive insect. Naumann says that in the autumn it feeds almost solely on berries; and Mr. Collett writes as follows:—"Amongst the berries on which this species feeds in the summer and autumn are those of the poisonous Paris quadrifolia. In the summer of 1860, I found a nest containing nearly fledged young of the garden warbler, and I put them in a cage, allowing the old ones to feed them. Besides cherries and other berries, the parent birds brought many of paris, of which an abundance grew all round. Some of these berries fell out of the cage on to the ground, but most were eaten by the young, whose droppings were strongly coloured by them, but they did not appear to disagree with them in the least; and I fed other birds also with these berries without any injury to them. Amongst others I gave to the young of the black-cap, white-throat, and robin these berries for food."



THE NIGHTINGALE (*Daulias luscinia*).

The nest of the garden warbler is placed in a low bush, amongst dense herbage, or in a bramble thicket, and is rather lightly though tolerably firmly constructed of grass bents and a few rootlets, intermixed with a little wool and moss, and lined with a little hair and fine roots. Naumann says that it seldom contains hair, and is very slightly constructed, so much so that after it is used it soon gets destroyed by the weather.

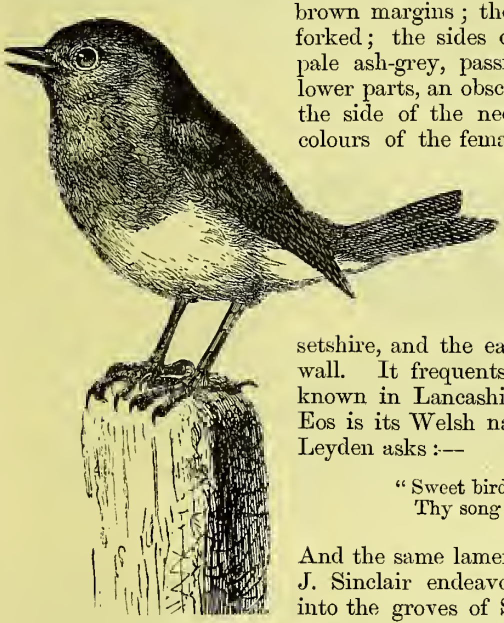
The Black-cap (*Curruca atricapilla*) is perhaps a regular summer visitant to certain districts, but must be considered very local in at least Ireland. Although pretty generally distributed in England, the black-cap, according to Mr. Macgillivray, is "met with sparingly in the southern districts of Scotland, and is remarked by Sir William Jardine to be rather local in his own vicinity in Dumfriesshire, having appeared there only within the last few years." Around Belfast are districts apparently well suited to this warbler, which is, however, of extremely rare occurrence.

The Nightingale (*Daulias luscinia*). The name of this bird is derived from the Saxon *night*, and *galam*, to sing, or the night-singer. Antony calls Cleopatra his "nightingale," and says:—

> The nightingale, if she should sing by day
> When every goose is cackling, would be thought
> No better a musician than a wren."

This charming bird may be traced from England, through Germany, Poland, France, Italy, and Palestine.

It is nearly the largest of all the warblers, being about seven inches in length, and eleven in the extent of its wings. The upper parts are of a deep yellowish-brown, inclining to reddish-brown; the quills and greater coverts are dusky brown, with reddish-brown margins; the tail deep reddish-brown, and very slightly forked; the sides of the neck, ear-coverts, breast, and flanks pale ash-grey, passing into greyish-white on the throat and lower parts, an obscure dusky streak going from the gape down the side of the neck and into the grey of the breast. The colours of the female are like those of the male. The bill is wood-brown, with the basal end of the lower mandible pale yellowish-brown; the tarsi, which are long, and the toes, are of the same colour.



THE ROBIN.

Though this warbler is plentiful in some localities, it is never found in others. It is found in Sussex, Dorsetshire, Somersetshire, and the eastern part of Devonshire, but not in Cornwall. It frequents a great part of Yorkshire, but it is unknown in Lancashire, though it has been heard in Carlisle. Eos is its Welsh name, but Wales is not known to possess it. Leyden asks:—

> "Sweet bird! how long shall Teviot's maids deplore
> Thy song unheard along her woodland shore?"

And the same lament may arise for the daughters of Erin. Sir J. Sinclair endeavoured to introduce this delightful songster into the groves of Scotland, exchanging the eggs of robins for those of nightingales. The young birds were hatched and brought up by their foster-parents; they migrated in September, their usual time, but never returned to the place of their birth. A similar experiment was made at Swansea, with the same result. Milton says:—

> "Sweet bird! that shunn'st the noise of folly,
> Most musical, most melancholy;
> Thee, chantress, oft the woods among
> I woo, to hear thy evening song."

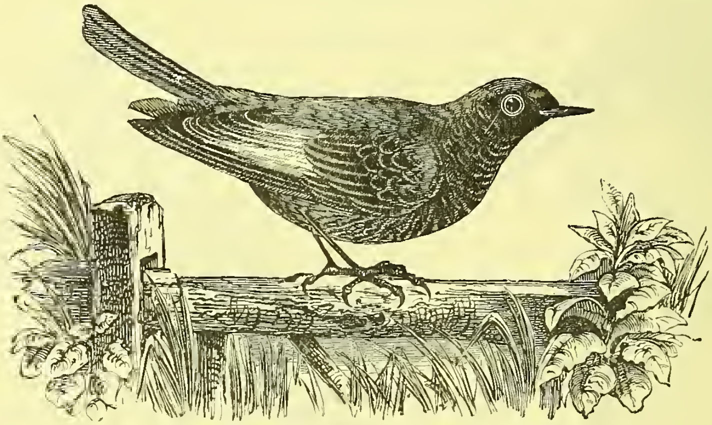
The Swedish Nightingale (*Daulias philomela*) does not occur in Great Britain, but is the only species found in Scandinavia. It is a larger bird than the nightingale.

The Robin Redbreast (*Erithacus rubecula*), with its "scarlet stomacher," is too well known to require any particular description. The female has the breast of a dull yellowish-brown, while the young ones are of a dull yellowish-green, without the orange-red on the breast.

In the bright days of summer the robin is shy and unobtrusive; it is, therefore, but little noticed, and its song is lost in the strains of the season. At first it is busy in preparing its nest, which is placed on the ground at the roots of trees and in other retired spots. Should the foliage here not afford a natural concealment, the birds form an artificial one of dry leaves, so that they may reach the nest without disclosing the site. The strewing of leaves on "the babes of the wood" was doubtless suggested to the minstrel by the female covering her eggs when she has to leave them. Like wrens, the redbreast often nestles near houses; but so cautious are they in leaving and returning home that the nests are seldom seen. The eggs are yellowish-grey, mottled with chestnut colour, and rarely exceed seven in number.

On the coming of autumn the robin loses the shyness of earlier months. He now traverses the grass-plot in search of insects, hops complacently up and down the gravelled walks of the garden, and leaves an unfortunate worm, only intent on looking out of its aperture in the soil, no chance of escape.

The Redstart (*Ruticilla phœnicurus*). Copses, on the borders of the woods, orchards, and gardens where insect food is abundant, are frequented by this visitor of ours during the spring and summer. It is very quick and animated in its movements, often catching its prey very skilfully on the wing. On the ground it trips along lightly and quickly, accompanying every action with a singular vibrating motion of the tail, which in the male is of a bright colour, in striking contrast with the rest of his plumage. It is in form and colour a very elegant bird, its upper surface being of a fine bluish-grey. The general plumage of the female is one uniform greyish-brown. The song is low, soft, and sweet, and generally uttered while the bird is perched on the topmost branch of a low tree. It imitates the notes of other species, and often, with excellent effect, mingles their strains with its own. This species is very extensively diffused on the Continent. It is abundant in France, Italy, and Spain; it also visits Germany, and extends its migration to Russia, Sweden, and Norway. The Black Redstart (*Ruticilla tithys*), an allied species, is common in the temperate parts of Europe and Asia, but only occasionally visits our island.



THE BLACK REDSTART (*Ruticilla tithys*).

The Wheatear (*Saxicola œnanthe*) is abundant in Europe, particularly on the northern shores of the Mediterranean. The upper parts of the body of the male are a sky-grey, the forehead, the band above the eyes, and the throat are white; black passes from the root of the bill below the eye, and covers the orifice of the ears; the wings are black; the rump and tail white for two-thirds of the length of the latter, the rest towards the end black, excepting the two middle feathers, which are entirely black; the front of the neck and breast are of buff-colour, the rest of the lower parts buffy-white.

The wheatear generally sits on the watch upon an elevated clod or stone for insects, which in great numbers it captures on the wing. Its flight is low, but smooth and rapid. Its song, though heard with difficulty in the open air, is soft and sweet; it is often poured forth as the male hovers over his mate, expanding the feathers of his tail.

They construct their nest of dried roots and feathers, as well as other materials, and deposit it in a place where it cannot easily be detected. It is stated that in Norfolk or Suffolk a deserted rabbit-burrow is usually chosen, and the nest is placed near the entrance. Mr. Salmon says in such situations it is sure to be discovered by the accumulation of a number of small pieces of the braken, which the old birds amass outside the entrance.

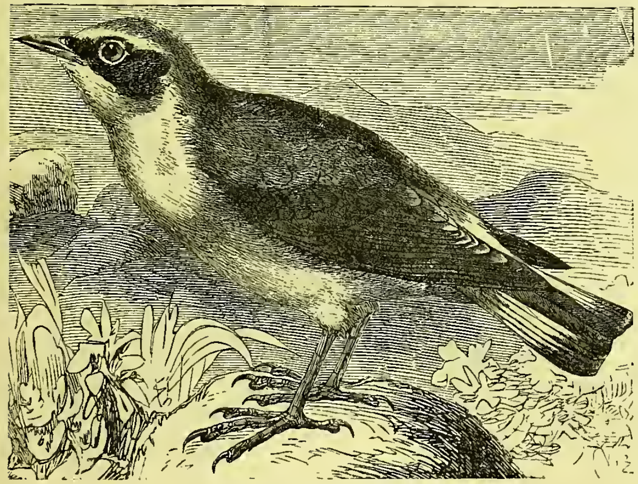
About the middle of September these birds visit the downs of Kent and Sussex in great numbers, which may be seen daily to increase. At this season they are caught in snares and traps for the table, being highly esteemed as delicacies. A shepherd has been known to take eighty-four dozen in a single day. About Eastbourne they abound, and were taken, Latham states, to the number of more than one thousand eight hundred dozens annually, in snares of horsehair.

THE STONE-CHAT (*Pratincola rubicola*).

The genus Copsychus contains seven species, found in tropical Africa and Asia. The Indian Dial-bird (*C. saularis*) is perhaps the best known; its song is excellent, and it is readily tamed. It is a very combative bird, and will fight like a gamecock. Specimens are captured by means of decoy birds. The Seychellean Dial-bird (*C. seychellarum*), recently described by Professor Newton, seems peculiar to the little group of islands from whence its name. It is about the size of a blackbird, of a black colour, with large white spots on its wings. Its notes are deliciously sweet and plaintive, the bird singing from the outmost bough of some tree, and constantly selecting the same spot; it is locally called the "pie chanteuse" and worthily deserves its name. My memory easily recalls some quiet warm evening, as I sat by the sea-shore of those tropical islands. There was no wind to rustle the easily-shaken leaves of the cocoa-nut palm; the ripple of the in-coming tide was hushed into quietness ere it broke on the coral sand it was hugging. The deep silence would be about to engender feelings of almost painful awe, when the plaintive notes of the dial-bird sounded on the ear, and changed the sadness into gladness by their soft soothing strains.

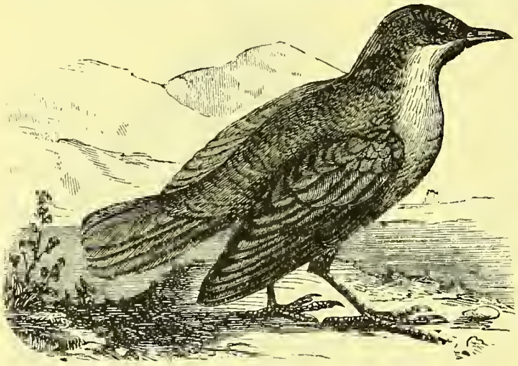
The Stone-Chat (*Pratincola rubicola*). This bird has a very extensive and varied range, being found in France, Germany, Russia, Provence, Italy, Smyrna, Japan, the Deccan, the banks of the Ganges, the mountain-chain of Upper Hindostan, Senegal, and South Africa, as well as England, Ireland, and Scotland; hence it bears a variety of names.

Dressed in its summer plumage, the male has the head, throat, back, and small coverts of the wings black, but each feather is finely bordered with ruddy brown, a great white spot on the sides of the neck, on the upper wings, and on the rump. The breast is deep ruddy, the lower parts very bright ruddy; the wing brown, bordered with brighter brown; the base of all the tail-feathers white; the rest of a blackish-brown. The female has the white spaces less extended and the ruddy colour less vivid.


THE WHEATEAR (*Saxicola œnanthe*).

These birds seldom appear on our heaths and commons, dappled with furze and bushes, before the end of March, but when its winds blow roughly, they quit the open spots for a shelter in the snug lanes and groves. As the season becomes genial they return, and the black, white, and brown of the stone-chat contrasts beautifully with the green and gold of the furze, as he sits on the topmost branch and takes his pleasure, springing a few feet into the air, hovering over the bushes or the stones, darting hither and thither, like a dragon-fly, over the margin of a brook in chase of insects, and chanting his little song, which, though low, is sweet and cheering to his mate, nestling in her little bower.

That bower is either on the ground or some dwarf bush. Outwardly it is a fabric of moss and grass, and within there is a lining of a few fine bents, hairs, and feathers. The eggs are pale-blue, with somewhat of a greyish tint, finely dotted with obscure reddish-brown at the large end.



THE DIPPER (*Cinclus aquaticus*).

The Hedge Sparrow (*Accentor modularis*). The nest of this well-known bird abounds in the hedges of our fields and gardens. Its eggs are of a beautiful azure blue. In summer the hedge-sparrow feeds eagerly on caterpillars, and hence checks the number of perfect insects; and, unlike most of the warblers, this little bird braves our wintry rigours, finds caterpillars hidden in the bark of trees, and adds to its meal berries and seeds.

The Timalidæ, or Babbling Thrushes, are a family of birds, small, with strong legs, met with in Asia, Africa, and Australia. As an example of the family we may mention the Black-faced Thrush (*Garrulax chinesis*). It is one of the best songsters in this group, and is a native of the mountainous regions of India and China. This bird is very gregarious in its habits, assembling in large flocks, and preferring the thickest jungles and deepest ravines to the open country. These flocks, although they are so deeply hidden, are easily discoverable by means of the extraordinary sounds they emit, and which are said to resemble a chorus of wild laughter. The food of this bird, when at liberty, consists chiefly of fruit and insects; but when tamed, it is rather carnivorous in its character. Its nest is formed of small twigs and grasses worked into some convenient hole in the side of a gully, and generally contains four eggs.

The Cinclidæ, or Dippers, are Alpine birds, of which one, the Dipper (*Cinclus aquaticus*), occurs in Britain. Conspicuous for his snowy breast and russet dress, and remarkable for his attitudes, this bird may well arrest the attention. He may be seen on some grey limestone mass, rising a foot or two out of the water, and placed in the centre or at the margin of the stream, jerking his head, dipping it down, and at the same time flirting up his short tail, then in an instant plunging into the water and disappearing suddenly, to rise at some distance, and settling again on some jutting crag or stone, he repeats the aquatic performance.

Nor is this bird of rare occurrence. It graces the rapid sparkling streams which flow through the romantic parts of our island. It is common in Wales, Scotland, and Ireland, and also in various parts of the Continent, particularly Switzerland, wherever rocks and mountain rivulets offer it a congenial abode. The nest of the Water Ouzel is composed of moss or rock-weeds, and is of a domed form, with a lateral entrance. Its food consists of small crustacea and aquatic insects, but not of fish, as used to be erroneously supposed. The young, before they are able to fly, are capable of diving with great address; indeed, when disturbed they take to the water instantly, although but half-fledged.

THE WREN (*Troglodytes europeus*).

The ear is startled by the sonorous song of this singular bird as it mingles with the hoarse tones of the torrent, or the rushing of the wintry water-fall, sometimes when there is a storm of snow. Mr. Rennie, who remarks "that it is one of the few birds that are vocal so early in the year as the months of January and February," heard it on the 11th of the latter month, when the thermometer in the morning had been at 26°, sing incessantly, not only elegantly, but powerfully, with much variety in the notes, many of which were peculiar to itself, intermingled with a little of the piping of the woodlark. The day was bright whilst it was singing, but it was freezing in the shade, and the sun, which had considerably passed the meridian, was obscured from the songster by the lofty surrounding hills.

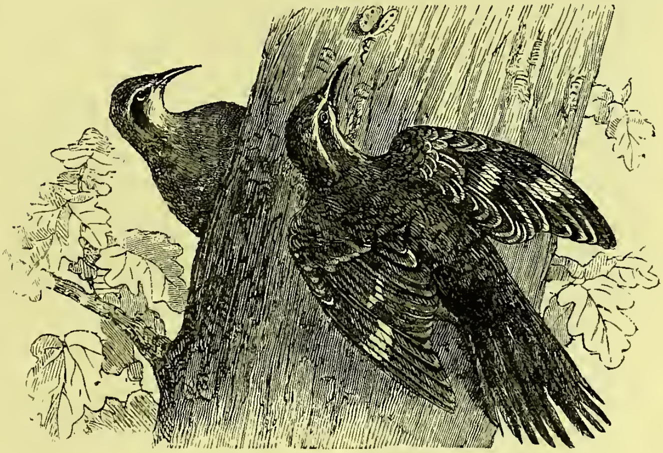
The Wrens, or Troglodytidæ, are a group of little birds, of which the Common Wren (*Troglodytes europæus*) is perhaps the best known. This bird frequents gardens, hedges, and groves near human dwellings, and builds its nest in a hay-stack, an old thorn-bush, or a hole in any old wall or building. It lays from eight to twelve eggs.

It used to be the practice, in many parts of Ireland, for men in their holiday attire, and decorated with gay and divers-coloured ribbons, to parade about on St. Stephen's Day. A furze-bush in which a wren was secured was borne along, when, as they stopped before the principal houses, one of them recited the following lines:—

> "The wren, the wren, the king of all birds,
> Was caught, St. Stephen's Day, in the furze.
> Although he's little his family's great;
> Then pray kind gentlefolks give him a trate."

Open flew the gates, and the attendants, if not the bird, were received with the utmost hospitality.

This practice seems founded on two singular traditions. One was that when the birds wished for a king, it was resolved that royalty should be conferred on the one that rose highest in the air, when a wren rose aloft while an eagle was ascending, perched on its back, and thus bore off the prize.



THE CREEPER (*Certhia familiaris*).

The other was that in one of the rebellions a party of Royalists, worn out with fatigue, were sleeping one night in a secluded valley, and just when the enemy had come within gun-shot, a wren tapped with its bill three times on the sentinel's drum and startled him, and he aroused the rest to a determined and victorious repulse.

Of the Creepers, or Certhiidæ, we may mention the Common Creeper (*Certhia familiaris*). Though of a somewhat lengthened form, is the smallest of British birds. It may be often seen during the autumn time, when the rustling woods are fragrant with the fallen leaves, flitting from the top of one trunk to the bottom of another, which it ascends by a kind of spiral progression, and then darting downwards to a neighbouring tree, it thus busily pursues from time to time its uninterrupted search. This bird chiefly shows itself in our shrubberies and wooded pleasure-grounds in winter.

It is a most active and restless little bird, ever on the alert, intent on picking up its food, which it finds on the trunks and branches of trees. Though a constant resident in Great Britain, it is not easily seen there, for its activity in shifting its position makes it very difficult to follow with the eye. One instant it is before the spectator, and the next, from the rapidity of its passage, the intervening branch or trunk hides the bird from his view. The form of its tail and the structure of its feet are exquisitely adapted to its rapid locomotion. Its oft-repeated note is monotonous.

This bird provides a nest in the hole or behind the bark of decayed trees, formed of dry grass, and the inner part of the bark is lined with small feathers. Here six or eight eggs are deposited. While the female sits on these she is regularly fed by the male bird.

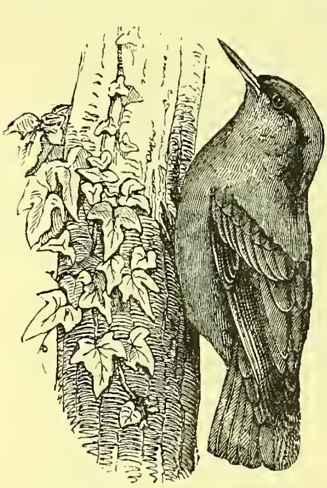
It not only inhabits Britain, but the Continent of Europe. It is said to migrate to Italy in September and October. It has been particularly noticed in various parts of

Germany, and is described as inhabiting North America. Prince Musignano states that it is common and permanent near Rome, and rare near Philadelphia.

The Wall-Creeper (*Trichodroma murarius*) is a much larger bird than the last. It is tolerably abundant in Spain and Italy, always, however, on the most elevated rocks, and is rare on mountains of moderate height. According to Temminck, it is never found in the north. This bird is common in Provence, and it may be seen creeping on the outer walls of St. Peter's, at Rome. It ascends the vertical faces of rocks as the common creeper does the trunks of trees: to these surfaces it can adhere firmly. Clefts and crevices of rocks are its favourite haunts, and sometimes, but very rarely, the trunks of trees. It feeds on insects, their caterpillars and chrysalises, and is particularly fond of spiders and their eggs.

In the spring, the throat of the bird is attired in black; this ornament disappears before the other feathers fall. It is impossible to distinguish the sexes after pairing and breeding-time. The young may be distinguished from their parents before their first moult, but in winter no difference is observable.

Of the NUTHATCHES, OR SITTIDÆ, we can only allude to the Nuthatch (*Sitta cæsia*). This species inhabits Europe and Asia, and seems to be little affected by the influence of climate. In Britain, as in most other countries, it is stationary, but local, and chiefly prefers wooded and enclosed situations, frequently selecting the deserted habitation of a woodpecker for its nest. In this case the entrance to the hole is first contracted by a plaster of clay or mud, to exclude larger birds, and leaving only sufficient room for itself to pass in and out. The male and female jointly labour at the construction of the nest, which usually consists of dead leaves and moss, heaped together without much order, and sometimes lined with the dust of the decayed trees in which the nest is placed. The number of the eggs is generally six or seven, and they are of a dirty white with dusky spots, being scarcely distinguishable from those of the greater titmouse. If the plaster at the entrance be destroyed when there are eggs in the nest, it is speedily replaced.

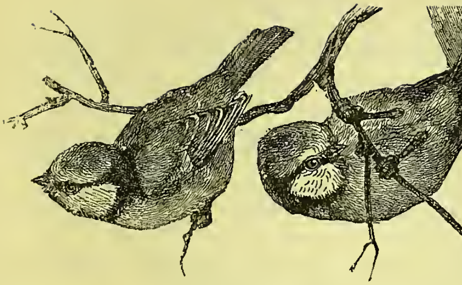


THE NUTHATCH (*Sitta cæsia*).

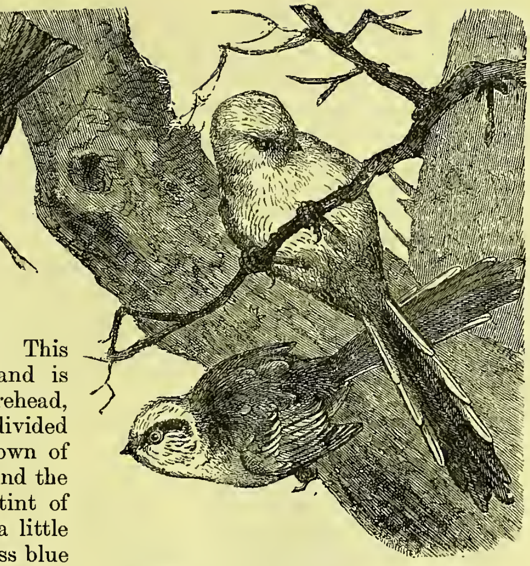
During incubation, the female is assiduously attended by the male, who regularly supplies her with food. Though easily driven from her nest at other times, she sits on her eggs with great pertinacity, striking the invader with her bill and wings, and hissing like a snake; and after every effort has been practised in vain, she will rather suffer herself to be taken than desert her charge. The eggs are hatched in May; and there is rarely more than one brood in the season. After the young can provide for themselves the family separates, and all seek retirement, though they are occasionally observed to mix with titmice and woodpeckers.

The nuthatch spends much of its time in climbing or creeping on trees; in climbing it is more expert than the woodpecker, for it runs up and down the tree in all directions. When employed in breaking a nut, its favourite position is with the head down. In the autumn it is no uncommon thing to find in the crevices of the bark of an old tree a great many broken nut-shells, the work of this bird, which repeatedly returns to the same spot for this purpose. When it has fixed the nut firm in a chink, it turns on all sides to strike it with the most advantage. This, with the common hazel-nut, is a work of some labour, but it strikes a filbert with ease. Whilst at work, it makes a rapping noise, which may be heard at some distance. In default of nuts and seeds, this bird searches for insects and their larvæ among moss or old trees, or walls, thatch, &c. In winter it picks the larvæ of beetles from under the bark of trees, and has recourse to its magazine of nuts, or other fruit.

The TITS, OR PARIDÆ, are a group of well-known birds, which are to be found from the North of Europe to Australia in the Old World, and from North America to Mexico in the New World. Space will only allow us to mention the following, out of nearly one hundred species:—



THE BLUE TITMOUSE.

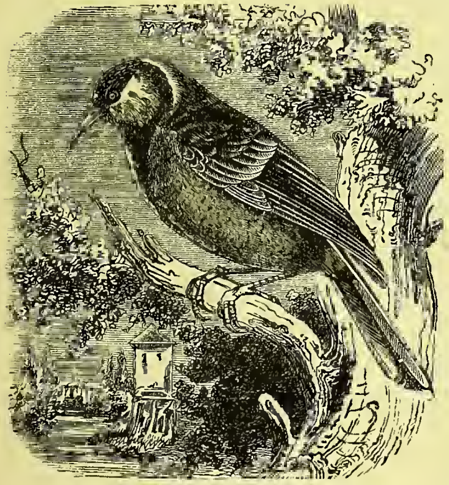


THE LONG-TAILED TITMOUSE (*Acredula caudatus*).

The Blue Titmouse (*Parus cœruleus*). This is a beautiful and lively little bird, and is sometimes called the Tom-tit. The forehead, sides of the head, and cheeks are white, divided by a black line across the eye; the crown of the head is blue; the nape and collar round the neck, bright azure; the back, a mixed tint of azure, grey, and green. The female is a little paler in the tints than the male, has less blue on the head, and is rather smaller in size.

The eggs of the Blue Tit are six or seven in number, rarely eight, white speckled with rust colour at the larger end. The female is tenacious of her nest, and will often suffer herself to be taken rather than quit it, and will frequently return again after being taken out. On such an occasion it menaces the invader in a singular manner, erecting all its feathers, and hissing like a snake, or uttering a noise like the spitting of a cat; and, if handled, pecks severely. It has no song, but makes a shrill chirping noise, quickly repeated. The blue tit is found in every part of Europe.

The Great Titmouse (*Parus major*). This bird remains throughout the year with us. It is found in different climates, as in the genial region of Italy and among the snows and ice of Russia. With us it inhabits woods, the neighbourhood of gardens, and other enclosed spots, in summer, and in winter it approaches the dwellings of men. It forms a nest of moss, which it lines with hair and feathers, and places in a hole of a wall, or the hollow of a tree, but sometimes chooses the deserted abode of a crow or a magpie. The eggs vary from six to nine in number; they are white, spotted and speckled with pale red.



THE GREAT TITMOUSE.

The Cole Titmouse (*Parus ater*). The patches of white on this bird render it easily distinguishable from others. Its favourite locality appears to be fir plantations, or plains that are rather high and dry, or on the outskirts of forests where the trees are more apart than in the centre, and never so completely lose their natural branches. This bird has a song, little else indeed than the same note repeated four or five times, but it has so much variety of pitch and tune as to form a kind of cadence, "which," it has been said, "would make a good variety anywhere, as it is shrill and clear; and which is particularly welcome and cheering in those mountain woods which the summer warblers but rarely visit." The bird sings in the noontide heat, when most birds—and especially those on the open wastes, with which the haunts of this species are usually interspersed—are silent.

The Long-tailed Titmouse (*Acredula caudatus*) may be frequently seen amidst woods, shrubberies, and tall hedges, as it remains in England throughout the year. Mr. Yarrell says:—"The nest of this species is an example of ingenious construction, combining beauty of appearance with security and warmth. In shape it is nearly oval, with one small hole in the upper part, through which the bird enters. I have never seen more than one hole. The outside of this nest sparkles with silver-coloured lichens adhering to a firm texture of moss and wool; the inside is profusely lined with soft feathers. The nest is generally placed in the middle of a thick bush, and so firmly fixed, that it is mostly found necessary to cut out the portion of the bush containing it, if you are desirous of preserving the natural appearance and form of the nest."

The BULBULS, OR PYCNONOTIDÆ, are nearly confined to the tropical regions of Africa; but some species are to be met with in Palestine, others in China and Japan.

The ORIOLES, OR ORIOLIDÆ. These Golden Thrushes are met with from Europe to Australia, not occurring in America. The best known species is the Golden Oriole (*Oriolus galbula*). The male is of a golden yellow, with a blackish-brown spot between the eye and the bill; the wings and tail are black; there is a yellow spot on the quills not far from the middle of the wing when closed, and the tail-feathers terminate with yellow; the bill is reddish-maroon; the iris is red; the feet are of a bluish-grey. It is in the third year that the male acquires his brilliant black and yellow plumage.

The golden oriole haunts lonely grooves and thickets on the skirts of woods, except in the fruit season, when it visits orchards and commits there serious ravages. The sportsman, if very clever in his imitative whistle, may so beguile the bird as to approach it, but so exquisite is its power of hearing that one false note will make it take wing. It is very fond of figs, grapes, and cherries, but these failing, it feeds on caterpillars and insects, as well as berries. Bechstein thinks that the word "pulilo" expresses the sound it emits; others state that its whistle is loud and flute-like. Its cup, or rather saucer-shaped nest, is formed of slender grass, stems, and wool; it is placed in the fork of a branch, and usually towards its extremity. Of Britain it is only an occasional visitant, appearing in April, but departing in September. It has been seen in various parts of our country, rarely in Ireland, and never, it seems, in Scotland.

THE GOLDEN ORIOLE (*Oriolus galbula*).

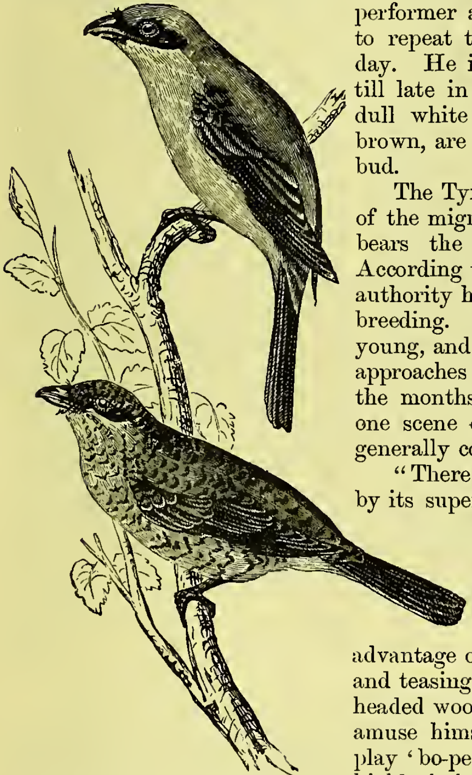
The CUCKOO SHRIKES, OR CAMPEPHAGIDÆ, are most abundant in Africa, but they are also found in Australia, and the Malay Archipelago. Pericrocotus speciosus is a very common bird in India, where its splendid plumage attracts great notice even from unscientific and casual observers. It seems to be solitary in its habits, being generally found alone or in small societies, in all probability consisting merely of the parents and their young. It is almost exclusively an insect-feeder, eating caterpillars, flies, ants, and various other kinds of insects, preferring, however, the beetles, of which it devours very great numbers. It is a suspicious and timorous bird, carefully avoiding the presence of human beings, and thus ranking as a very scarce bird, although it probably exists in considerable numbers in its own peculiar localities.

The so-called caterpillar-eaters belonging to the typical genus (Campephaga) are to be met with in the Malays, the Philippines, and New Caledonia.

The next family would be that of the DRONGA SHRIKES, OR DICRURIDÆ, and to this follows the large family of the FLY-CATCHERS, OR MUSCICAPIDÆ. Of these we can only enumerate the following:—

The Pied Fly-catcher (*Musicapa atricapilla*) is a native of England. The forehead of the male, a large band across each wing occupying the secondaries, and the edge of the outer tail-feather on each side are pure white; the rest of the upper surface is jet-black; the under surface is white. The female, as also the young, are destitute of white, and have the upper surface of an ashy-brown. In autumn the male assumes an attire like that of the female, but in spring he is seen in his characteristic plumage. The birds breed in holes, or in thick or close bushes, forming their nests of dried leaves, and lining them with hair or feathers. The eggs seldom exceed five; they are of a pale greenish-blue.

The Spotted Fly-catcher (*Musicapa griseola*) can hardly be said to be a song-bird, for a chirping call-note forms its whole musical stock; but it is one of the most welcome and constant of our migratory birds, and the untiring zeal with which it clears the neighbourhood of small insects, such as gnats, makes it a cherished guest. Perched on the top of a stake or a post, or an upper gate-bar, or an outlying branch, the bird remains motionless, till some luckless insect, humming his lay quite carelessly, comes within his range. Off darts the fly-catcher, finishing the song and the life of the performer at the same instant, and returns to his station to repeat the exterminating process through the whole day. He is one of our latest visitors, seldom arriving till late in May, and his quiet hair-brown coat, and his dull white waistcoat, spotted and streaked with dark brown, are rarely seen till the oak-leaf has well burst the bud.


THE GREAT GREY SHRIKE.

The Tyrant Fly-catcher (*Tyrranus intrepidus*) is one of the migratory visitors of the United States, and often bears the name of "King," as well as "Tyrant." According to Wilson, he does so from the extraordinary authority he assumes over all others during the time of breeding. So great is his affection for his mate, his young, and his nest, that, suspicious of every bird that approaches it, he violently attacks all intruders. In the months of May, June, and part of July, his life is one scene of broils and battles, in which, however, he generally comes off conqueror.

"There is one bird, however," says Wilson, "which, by its superior rapidity of flight, is sometimes more than a match for him, and I have several times witnessed his precipitate retreat before this active antagonist. This is the purple martin, one whose food and disposition are pretty similar to his own, but who has greatly the advantage of him on the wing, in eluding all his attacks, and teasing him as he pleases. I have also seen the red-headed woodpecker, while clinging on a rail of the fence, amuse himself with the violence of the king bird, and play 'bo-peep' with him round the rail, while the latter, highly irritated, made every attempt, as he swept from side to side, to strike him, but in vain. All his turbulence, however, subsides as soon as his young are able to shift for themselves, and he is then as mild and peaceable as any other bird."

These birds have no power of song. They arrive in Pennsylvania about the 20th of April, sometimes in small bodies of five or six, and are at first very silent, until they begin to pair and build their nests. This generally occurs about the first week in May. The nest is frequently built on the horizontal branch of an apple-tree in an orchard, or on a sassafras-tree, at no great height from the ground. The outside consists of small slender twigs, tops of withered flowers of the yarrow and others, well woven together with tow and wool. It is made large and remarkably firm and compact; it is usually lined with dry fibrous grass and horse-hair.

The eggs are five, of a very pale cream-colour or dull white, marked with a few large spots of deep purple, and other smaller ones of light brown. These birds generally build twice in the season.

The SHRIKES, OR LANIDÆ, are divided by some into the Thick-headed Shrikes (*Pachycephalidæ*) and the True Shrikes. The Great Shrike (*Lanius excubitor*) is a native both of Europe and America, and is generally about ten inches in length. The upper parts of the plumage are of a pale ash-colour, and the wings and tail are black varied with white. The throat, breast, and belly are of a dirty white, and the legs are black. The female differs very little in appearance from the male.

THE RED-BACKED SHRIKE.

It preys chiefly on beetles, dragon-flies, and other large insects, and, as is also the case with others of this family, it impales them on thorns or sharp spikes, leaving them to be devoured at leisure, or if hungry, immediately tearing them in pieces, hence they have received the name of Butcher Birds. In addition, however, to insects, the great shrike preys on frogs, mice, and small birds, which it does not strike like the hawk, but attacks with great ferocity, destroying them by crushing in their skulls with its strong bill, grasping them at the same time with its toes, which, though slender, are armed with sharp claws, and capable of being very firmly compressed.

Mr. Bell, who travelled from Moscow through Siberia to Pekin, says, that in Russia these birds are often kept tame in the houses. He had one given him which he taught to perch on a sharpened stick fixed in the wall of his apartment. Whenever a small bird was let loose in the room the shrike would immediately fly from his perch and seize it by the throat so as almost instantly to suffocate it. He would then carry it to his perch, and spit it on the sharpened end, drawing it on carefully and forcibly with his bill and claws. If several birds were given him he would treat them all, one after the other, in the same manner. These were so fixed that they hung by the neck until he was at leisure to devour them. A gentleman in America, observing that grasshoppers were stuck upon the sharp thorny branches of the trees, inquired the cause, and was told they were thus spitted by the great shrike. On further inquiry, he was led to suppose that this was an instinctive stratagem adopted by the shrike in order to decoy the smaller birds which fed on insects into a situation from whence he could dart and seize them. He is called in America "Nine-killer," from the notion that he thus sticks up nine grasshoppers in succession. That the insects are placed there as a bait is said to appear from their being frequently left untouched for a considerable time. Wilson, however, calls this "a very pretty fanciful theory," and maintains that the shrike can seize on small birds by mere force of flight. "I have seen him," he says, "in an open field dart after one of our small sparrows with the rapidity of an arrow, and kill it almost instantly."

This bird frequents the deepest forests, builds a large and compact nest in the upright fork of a small tree, composed outwardly of dry grass and moss, and warmly lined with feathers. The female lays six eggs of a pale cinereous colour thickly marked at the greater end with rufous spots and streaks.

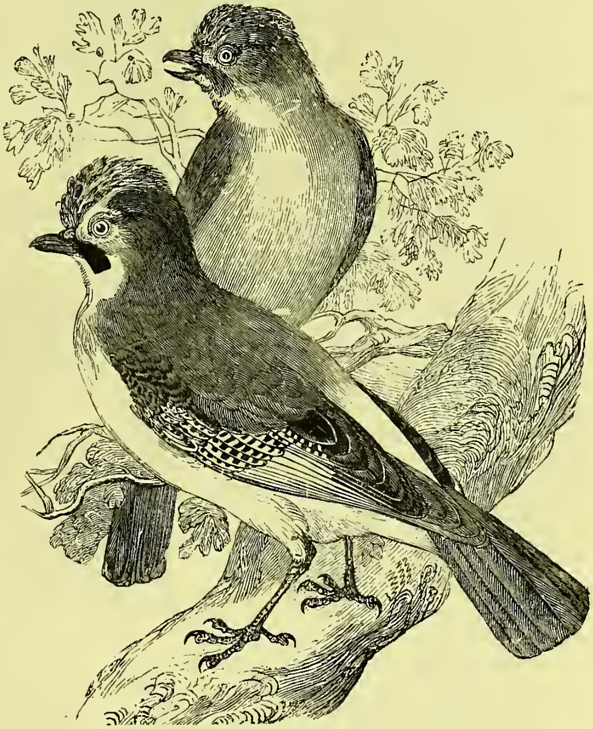
THE PIPING CROW (*Gymnorhina tibicen*).

The Crows, or Corvidæ. This is a very extensive family, and a somewhat mixed one, containing, as it does, the Piping Crows, the Jays, Tree Crows, Magpies, and Choughs. We shall allude to one or two species belonging to each section. The Piping Crow of the Australian Colonists (*Gymnorhina tibicen*) is common in New South Wales. MM. Quoy and Gaimard, the able naturalists attached to Freycinet's expedition, saw numbers of them on the Blue Mountains, living gregariously in small troops. The bird brought home by Freycinet reached France alive, and, by its good-natured and amusing manners, became a great favourite on shipboard. It was a skilful mimic, and clucked and cackled like a hen; but its imitation of a young cock was complete. It had been trained to whistle airs at Port Jackson, and some of these it appeared to forget, but recollected them on being prompted.

The Pied Crow (*Strepera graculina*) is widely diffused through New South Wales.

Of the Jays, the Common Jay (*Garrulus glandarius*) must be mentioned. It is one of the most ornamental of our indigenous birds. It dwells in woods, beyond the outskirts of which it seldom wanders. Its food consists of insects, fruits, and forest seeds.

The jay builds its basket-like nest in trees or high coppice-wood and hedges, and lays five or six eggs of a dull whitish-olive, mottled very obscurely with pale brown. Towards the large end there are usually two or three black lines.


THE COMMON JAY (*Garrulus glandarius*).

The jays rarely come into the open country, but make great havoc in gardens and cultivated grounds in the neighbourhood of woodlands. Their food is much less varied than that of the true crows, but they still may be styled omnivorous. Their plumage is generally grey and even brilliant; and there is a beautiful blue patch on their wings. But showy as the jay is, it is much more frequently heard than seen; nor is it easy to observe it at all, for the more it is followed, the deeper does it plunge into the thick of the coppice.

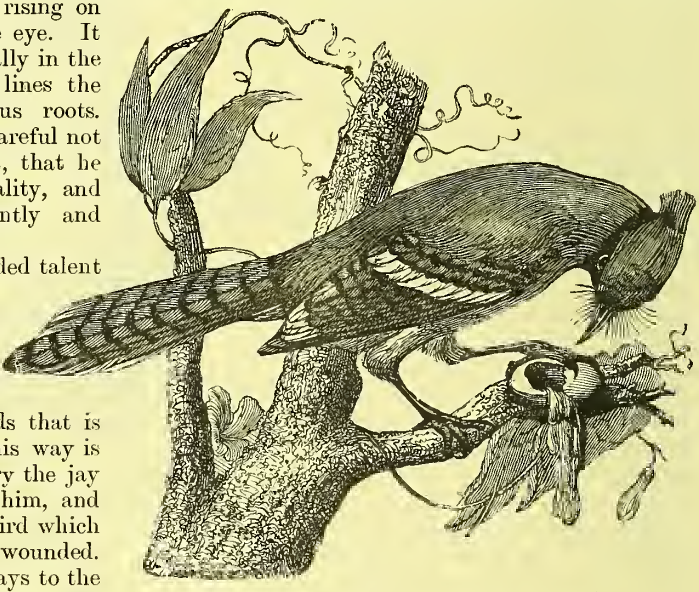
Jays neither flock nor have meetings similar to those of the magpies and some of those crows that breed apart from each other; nor—though it has been observed in some instances—has it been fully proved that the young remain with the old birds after they are completely fledged and capable of finding their own food. They are, indeed, much more predatory than the magpies, though considerably smaller. They occasionally pounce on birds, and kill and devour them; they are very destructive to the eggs of small birds, and they will eagerly catch mice.

One of the most remarkable peculiarities of the jays is the volubility of their sounds. The alarm-note the bird utters on the appearance of danger, or even of a stranger in its haunts, is extremely harsh, but it has a love-note singularly soft, "yet so low and apparently cautious, that it seems whispering to its mate, as if to hide their affections and labours from the other tenants of the grove. Even then it is very imitative, and though it does not attempt the songs of the warblers, it is very adroit at bleating, screaming, neighing, and, in short, imitating all the harsher sounds. Bewick says:—"We have heard one imitate the sound made by the action of a saw so exactly, that, though it was on a Sunday, we could hardly be persuaded that the person who kept it had not a carpenter at work in the house."

The American Blue Jay (*Garrulus cristatus*) is peculiar to North America, and is regarded with great interest on account of the brilliancy of his plumage, the address of his tones and gestures, and his strange loquacity. He is an almost universal inhabitant of the woods, frequenting the deepest recesses of the forest, where, in the spring, he pours forth his harmony in every thicket, and where his squalling voice often alarms the deer, to the great indignation of the hunter. He has great variety of undulations of voice, according to the humour of the moment, while there is scarcely a bird to whose peculiarities of song he cannot tune his note. Sometimes he indulges in soft chatterings like those of the duck, but no sooner does he discover the approach of a stranger, than he sets up a sudden and vehement outcry, flying off from the thick foilage of the cedar where he has been concealed, and screaming with all his might, as if calling all the feathered tribes of the neighbourhood to witness some outrageous usage he had received. The call-note which he utters to the female has been described by Wilson as easily mistaken by a stranger for the repeated "screakings" of an ungreased wheelbarrow.

This jay measures seven inches in length, the head being ornamented with a crest of light-blue or purple feathers, which he can elevate or depress, while a narrow line of black runs along the frontlet, rising on each side higher than the eye. It builds a large nest, usually in the cedar or apple-tree, and lines the interior with dry fibrous roots. The male is especially careful not to be seen near the spot, that he may not betray the locality, and pays his visits as silently and secretly as possible.

This bird has a decided talent for mimicking, and also for teasing others of its feathered companions, from which it appears to derive no common satisfaction. One of the birds that is especially annoyed in this way is the little hawk, whose cry the jay imitates when it meets him, and feigns the shrieks of a bird which has been captured and wounded. This noise brings other jays to the scene of action, and they all join in the annoyances of the hawk. The hawk, however, is not to be outdone, and at length, singling out one of the more prominent of its tormenters, seizes it in an unguarded moment, and sacrifices it to his hunger and resentment. Instantly the tone of the other birds is changed, and with loud cries they proclaim the tragical conclusion of the sport.


THE AMERICAN BLUE JAY (*Garrulus cristatus*).

Of the Tree Crows we can only mention—

The Benteot (*Crypsirhina varia*) of Java. According to Mr. Horsfield, "it may be often seen about noon, sailing heavily through the air in a right line towards the trees surrounding the openings in the forest." The strong bill and powerful claws show that the bird is well adapted for the capture of insects, and disinterring them from their subterranean hiding-places, as well as for eating the various hard-shelled fruits on which it partly subsists. In colour, the benteot appears at a little distance to be nearly black, but on close approach its plumage is seen to be a very dark and rather dull green, "shot plentifully with a deeper line of bronze."

And another lonely magpie-like bird called the Wandering Pie (*Temnurus vagabundus*) is so called on account of its habit of wandering over a very large extent of country, travelling from place to place, and finding its food as it best may, after the fashion of a mendicant friar. This custom is quite opposed to the general habits of the pies, who are remarkable for their attachment to definite localities, and can generally be found wherever the observer has discovered the particular spot which they have selected for their home. Mr. Gould suggests that its wandering habit may be occasioned by the necessity for obtaining subsistence, the wandering pie feeding more exclusively on fruits and other vegetable nutriment than is generally the case with the crow tribe, and being, therefore, forced to range over a large extent of land in search of its food.

Of the true crows, allusion must be made to the Nutcracker (*Nucifraga caryocatactes*).

MAGPIE AND NEST (*Picá caudata*).

It is a rare native of Britain. The manners of this bird are said to resemble those of the jay, but other circumstances connected with its food and organisation bring it into alliance with the crows, to which family it is mostly referred by ornithologists. Like the jay, it feeds on nuts and berries, as well as on the seeds of the pine, of which it appears to be very fond; but, like the woodpecker, it climbs the trunks and branches of trees, tapping the bark with its bill, to start the insects and their larvæ that may lurk beneath, and devour them. It is said to crack nuts much in the same way as the nuthatch. The nest is formed in the hollows of trees which the bird is supposed to enlarge after the manner of the woodpecker. The eggs are five or six in number, of a yellowish-white or grey, with a few spots of bright grey-brown.

The Magpie (*Pica caudata*) is one of the most beautiful species of this country, but loses much of its lustre in a state of captivity. The magpie is very common in England, and feeds on both animal and vegetable substances, frequently killing young ducks and chickens. It is said also occasionally to pick out the eyes of lambs, hares, &c., if weak; it also eats insects, fruits, and even grain.

No birds display more industry in the construction of their nests. They generally select the summit of the highest trees, especially if standing alone in a row; but in forests or very retired situations, they sometimes choose a mere bush for the purpose. The male and female begin this work together in February, placing the nest not, like the rook, in full sight of all from the ground, but so enveloped and surrounded with branches, that when the leaves appear the nest is concealed.

The nest is made of small branches well interlaced together, leaving an aperture only in the side. The bottom of the nest is furnished with a matting of soft and flexible roots; and although the diameter of the inside of the nest does not much exceed six inches, it is upwards of two feet on the outside. It is said to occupy the birds two months to build this nest, and M. Viellot has observed that if the nest is destroyed, or the birds are prevented from finishing it, they either content themselves with an old nest of their own species, or take to an old crow's nest after repairing the outside. The same gentleman has also noticed that, at the early part of the breeding season, each pair of these birds begin more nests than one, though they finish that only in which the eggs are deposited.

Ordinarily they have but one brood in the year; but if their young be destroyed, they will sometimes have a second, and even a third. The eggs, seven or eight in number, are yellowish-white, spotted with brown or grey. The male and female sit alternately, and the incubation continues about fourteen days. The young are born blind, and remain so several days. The parents display great care of them, and continue their attentions a considerable time.

It will be remembered that Chaucer, in his "Canterbury Tales," thus gives two traits of the miller's wife:—

> "And she was proud and pert as is a pie."

The Raven (*Corvus corax*) is the largest species of British crow; it is black, but there are purplish reflections on the upper part of the body, and greenish tints underneath. The female is distinguished by a colour less deep, by a weaker bill, and by being rather smaller than the male. The plumage of the young, also, is not so decided a black, and it is without reflections.

Carrion and putrid animal matter—which they can smell at a great distance—forms the basis of the food of these birds; when such, however, is not forthcoming, they live on fruits, grain, insects, dead fish, and molluscous animals, whose shells they break against the stones. It is said that they will at times attack living animals, as rats, partridges, and frogs, and that falling on the back of the larger sort, as asses and buffaloes, they will seriously injure them by repeated strokes of their bills. The fetid nature of their food renders these birds unfit for the table. They were unclean to the Jews, and are generally considered in a similar light by most savage nations.

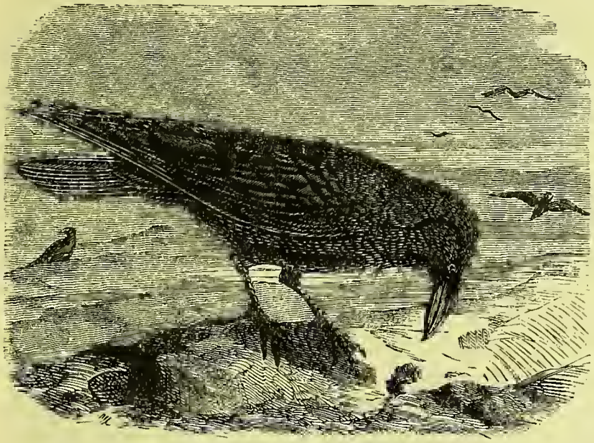
They are also greatly attached to one another, and live, in general, in pairs, each pair remaining connected for several years, probably for the whole period of their lives. They make their nests in the crevices of the rocks, in holes towards the tops of deserted towers, and sometimes on the summit of an isolated tree. This nest, which is very large, is composed exteriorly of branches and roots; bones of quadrupeds, or fragments of hard substances, form the second coat; and the interior is lined with moss, &c. The female lays, about the month of March, five or six pale greenish and bluish eggs, lined and spotted with a neutral tint; both the male and female sit, and the incubation lasts about twenty days. There may be generally found in the vicinity of these nests a considerable accumulation of grains, nuts, fruits, and other things, though it appears these hoards are rather made by the instinctive impulse of the bird than for the use of the young. These at their birth are whitish.

The young are ready about the month of May to quit the nest. So long as they are but partially able to provide for themselves, the parents bring them food during the day, and every evening the family re-assemble in the nest, and this practice continues the whole summer, which has led to the presumption that they breed more than once in the year. Though not quick breeders, however, these birds are very long-lived. When the young have attained strength enough to provide altogether for themselves, the old birds drive them from their own adopted vicinity to seek an asylum elsewhere.

The power which the raven has of clear articulation is well known. Mr. Swainson says:—"One belonging to Mr. Henslow, of St. Albans, speaks so distinctly, that when first we heard it we were actually deceived in thinking it was a human voice." And every one well remembers Charles Dickens' raven "Grip."

The Rook (*Corvus frugilegus*). The rook bears a great resemblance to the carrion crow, and at first sight it is difficult to distinguish the one from the other. The principal distinctive character consists in the nudity of the base of the bill and of the forehead, and upper part of the throat, in the rook, which parts are covered with feathers in the carrion crow; but this is not observable in the young bird, who has feathers at the base of the beak, projecting forward over the nostrils. These disappear after the first month. The voice, too, is quite different in the crow and the rook: the croak of the crow is much the harsher of the two. Crows are solitary in their habits, while rooks are not only gregarious, but seem to prefer a habitation near the dwellings of man. The birds of the species we are now describing all breed early in March, and the young birds are hatched in April.

The rook feeds chiefly upon grubs. Prince Bonaparte says that he eats grain also; and that so great was the mischief done by him to the first settlers in North America, that a reward was given for every bird that was killed. It was soon, however, discovered that the worms and insects were so much more formidable than the bird that he was no longer molested. The same is probably the case in England. The rook is said to be particularly fond of the larvæ of the cockchafer: whence these destructive grubs are in some places called rook-worms.

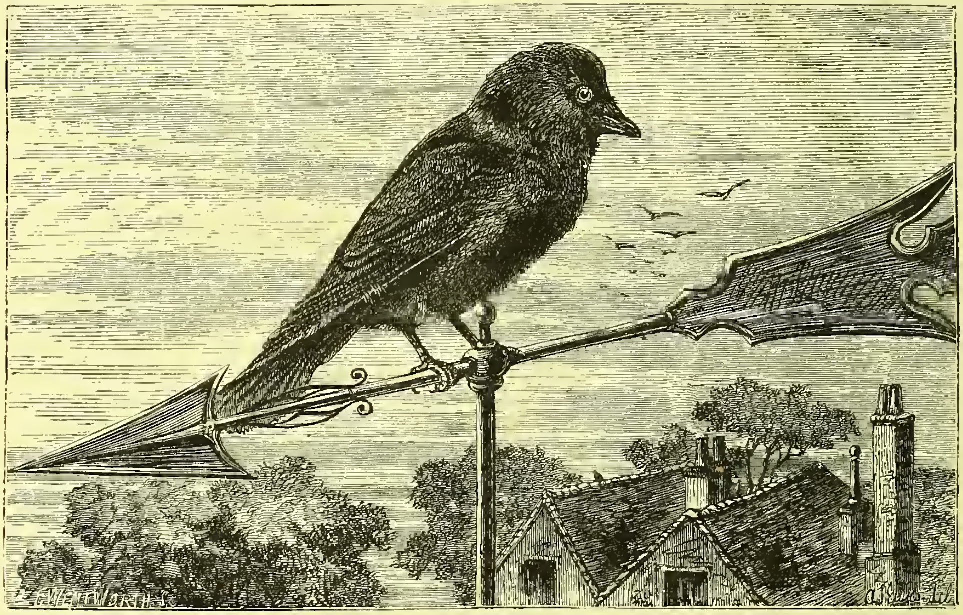

THE RAVEN (*Corvus corax*).

These birds seem partial to our island, as they remain here the whole year; but in France, and most parts of Europe, especially to the south, they are birds of passage; and in Spain, it is said, are not known. Their gregarious disposition, particularly during incubation, on the tops of lofty trees, is a familiar fact. After the breeding season they disperse, and in a great measure abandon the rookery in which they have bred their young. The eggs, five in number, a little smaller than those of the crow, are bluish-green, with dark blotches. They begin to build early in March, and the male and female sit by turns. White and pied varieties are sometimes seen.

The Carrion Crow (*Corvus corone*) may be described as a small raven; it lives in pairs all the year, and it is a rare thing to see more than two together in any place. They are omnivorous in the fullest sense of the term, and will poke their beaks into everything they can find, from a boiled potato to a dead horse. In winter it associates with the rooks and ravens, and may be seen with them on fresh-turned earth, searching for worms, insects, and their larvæ. Early in the spring, when the rooks quit the south of Europe in flocks to build their elevated cities in the high trees in the north, the carrion crows separate into pairs, and proceed alone in the great work of nidification. The nest, like that of the rook, is constructed at the summit of a tree of slender branches, matted with clay and horsedung, and lined with fibres. The female lays four or five eggs, of a palish green, with obscure spots and bars.

The old birds have great affection for their young, which remain a long time under their fostering care, and to which the parents have the address to carry the eggs of partridges in their bills. They lay but once in the year, unless the eggs or young be destroyed by accident. They will engage with rapacious birds in defence of their young and eggs. It is said that the conjugal union of these birds continues during life.

The Jackdaw (*Corvus monedula*) is the smallest of the tribe, being only about half the weight of the rook; but the wings are larger in proportion. It is about fourteen inches long, twenty-nine broad, and weighs between nine and ten ounces. The bill, feet, top of the head, wing-coverts, and secondary quills, are black; the back of the head and nape smoke-grey, and the eyes the same, but much lighter; the remaining parts black, with a greyish tinge on the upper side, and a bluish on the under. The black is variously glossed with blue and violet reflections. These are the ordinary colours; but like all birds that inhabit cultivated lands, and are of course affected by the differences to which cultivation gives rise, jackdaws vary considerably in colour, partly from age, partly not; sometimes the grey is nearly white, at other times the bird is black all over, and there are many slighter and intermediate variations.

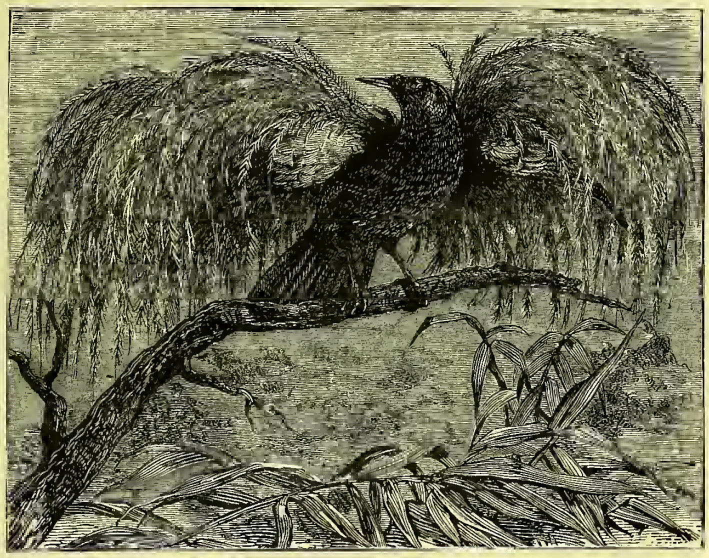


THE JACKDAW (*Corvus monedula*).

Holes and chinks are the immediate places in which jackdaws nestle; but these must be elevated above the level ground, and the higher they are the better the bird likes them. It is probable that the original instinct is the protection of its eggs and young from the weasels. Rocks, the edges of neglected quarries, the projecting parapets of bridges, towers, steeples, ruins, and various other places, are the haunts of this bird.

The Chough (*Fregilus graculus*). This very handsome bird is locally distributed, but is, perhaps, not so rare as has been generally believed. In Britain it only frequents sea-coasts, never venturing far inland; and, in this respect, seems to differ considerably from the bird on the Continent, where Alpine inland districts are in part inhabited by them. In Britain, the rocky coasts of Devon and Cornwall, various parts of Wales, and some of the adjacent isles, are its southern localities; in Scotland, St. Abb's Head on the eastern side, and the shores of Wigtonshire and Galloway on the western, are frequented; and we learn that it has reached even the Hebrides. In Ireland, Mr. Thompson writes :—"The chough frequents the sea-coast chiefly, and occurs in certain localities in the north, south, and west of Ireland. It appears to be also most abundant in the Isle of Man, an island which has rocky precipitous coasts for at least two-thirds of its circumference. Round these shores it is so common, that many little flocks of them will be met with in the course of a forenoon's walk. The habits of the bird, as well as the flight and manner of alighting among the rocks and fissures, very considerably resemble those of the jackdaw; so much so that when Mudie first enjoyed the satisfaction of seeing this bird on a part of the mainland where they were not so frequent, he mistook their flight for that of the last-named bird, and missed some opportunities of procuring what he then considered a very rare bird. A glimpse of their red legs first undeceived him. "During the breeding season," he says, "when we have chiefly seen these birds, we found them almost constantly on the coast, near the caves and fissures where the nests were placed, and they were very seldom seen more than a quarter of a mile inland; but they made excursions so far, alighting among the rocky parts of the upland sheep-pastures, and occasionally feeding and walking on the dry pasture itself, where they appeared to procure insects, their stomachs being chiefly at this time filled with coleoptera. It is also said to feed on grains and berries; and we are not aware of any particular food afforded by the rocky British coasts, which in that country so peculiarly attracts them to such localities; while on the Continent, the Alpine ranges or the borders of the snow-lines are their usual haunts."

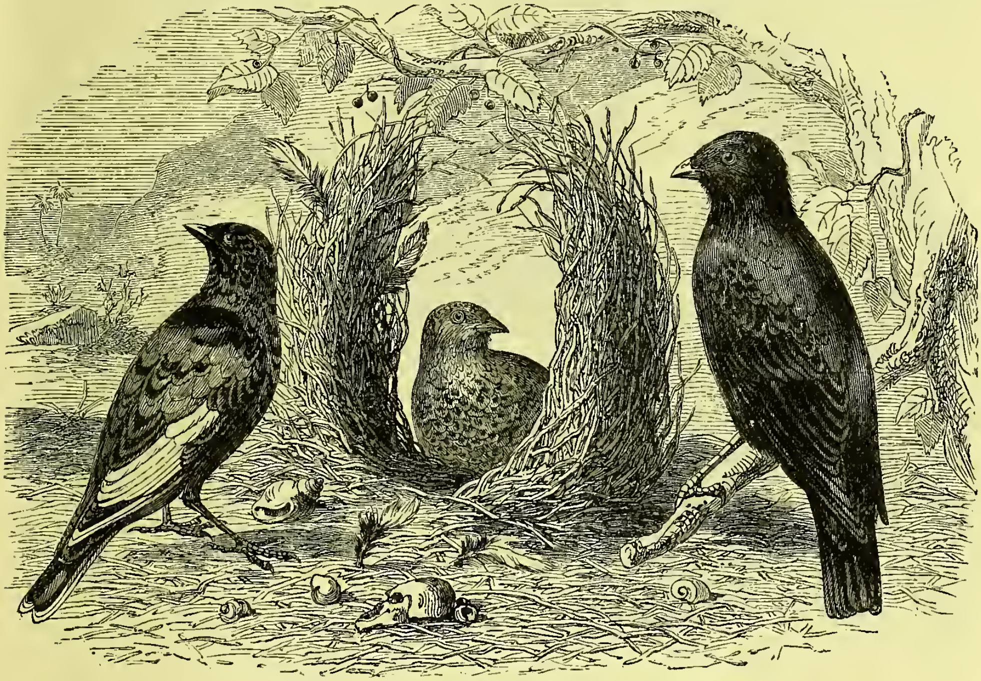
This beautiful species is entirely of a deep glossy-black above, with steel-blue and green reflections; the plumage on the head and neck is rather loose, and tinted with purple; underneath it is of a deep and uniform tint, with less lustre. The bill is of a brilliant vermilion red, strong, bending for the whole length, and without any trace of a notch; the plumes covering the nostrils are close and stiff, and appear as if rounded off with scissors on the bill. The legs and feet are of the most brilliant tint with the bill, and are strongly formed; the claws brownish-black, crooked, and strong; the development of the wings and tail large and powerful, the flight consequently light and buoyant; the length about fifteen inches. The bill and legs of the young do not show for some time the brilliant red colour.



THE GREAT BIRD OF PARADISE (*Paradisea apoda*).

The Paradise Birds, or Paradiseidæ, are quite unsurpassed for the beauty of their plumage, and form a contrast with most birds from the strange and wonderful development of their wing and tail-coverts. These glorious birds should be seen in a museum (seeing them in their native haunts is reserved for the few), and to those who cannot do this we would suggest a look at Mr. Elliot's splendid work on this family. Including, as he does, the Bower Birds in the same group, we find these birds limited to New Guinea, the Papuan Islands, with a few species to be met with in North and East Australia. The Great Bird of Paradise (*Paradisea apoda* of Linnæus) must at least be noticed. Mr. Wallace tell us "that it is the largest species known, being generally seventeen or eighteen inches from the beak to the tip of the tail. The body, wings, and tail are of a rich coffee brown, which deepens on the breast to a blackish-violet or purple-brown. The whole top of the head and neck is of an exceedingly delicate straw-yellow, the feathers being short and close set, so as to resemble plush or velvet; the lower part of the throat up to the eye is clothed with scaly feathers of an emerald green colour, and with a rich metallic gloss, and velvety plumes of a still deeper green extend in a band across the forehead and chin as far as the eye, which is bright yellow. The beak is pale lead blue; and the feet, which are rather large and very strong and well formed, are a pale ashy pink. The two middle feathers of the tail have no webs, except a very small one at the base and at the extreme tip, forming wire-like cirrhi, which spread out in an elegant double curve, and vary from twenty-four to thirty-four inches long. From each side of the body beneath the wings springs a dense tuft of long and delicate plumes, sometimes two feet in length, of the most intense golden-orange colour, and very glossy, but changing towards the tips into a pale brown. This tuft of plumage can be elevated and spread out at pleasure, so as almost to conceal the body of the bird. These splendid ornaments are entirely confined to the male sex, while the female is really a very plain and ordinary-looking bird of an uniform coffee brown colour, which never changes; neither does she possess the long tail wires, nor a single yellow or green feather about the head. The young males of the first year exactly resemble the females, so that they can only be distinguished by dissection. The first change is the acquisition of the yellow and green colour on the head and throat, and at the same time the two middle tail feathers grow a few inches longer than the rest, but remain webbed on both sides. At a later period these feathers are replaced by the long bare shafts of the full length, as in the adult bird; but there is still no sign of the magnificent orange side plumes, which, later still, complete the attire of the perfect male. To effect these changes there must be at least three successive moultings; and as the birds were found by me in all the stages about the same time, it is probable that they moult only once a year, and that the full plumage is not acquired till the bird is four years old. It was long thought that the fine train of feathers was assumed for a short time only at the breeding season; but my own experience, as well as the observation of birds of an allied species which I brought home with me, and which lived two years in this country, show that the complete plumage is retained during the whole year, except during a short period of moulting, as with most other birds. The Great Bird of Paradise is very active and vigorous, and seems to be in constant motion all day long. It is very abundant, small flocks of females and young males being constantly met with; and though the full-plumaged birds are less plentiful, their loud cries, which are heard daily, show that they also are very numerous. Their note is 'Wawk-wawk-wawk'—'Wôk, wôk-wôk,' and is so loud and shrill as to be heard a great distance, and to form the most prominent and characteristic animal sound in the Aru islands. The mode of nidification is unknown; but the natives told me that the nest was formed of leaves placed on an ant's nest, or on some projecting limb of a very lofty tree, and they believe that it contains only one young bird. The egg is quite unknown, and the natives declared they had never seen it; and a very high reward offered for one by a Dutch official did not meet with success. They moult about January or February, and in May, when they are in full plumage, the males assemble early in the morning to exhibit themselves in the most singular manner. This habit enables the natives to obtain specimens with comparative ease. As soon as they find that the birds have fixed upon a tree on which to assemble, they build a little shelter of palm-leaves in a convenient place among the branches, and the hunter ensconces himself in it before daylight, armed with his bow and a number of arrows terminating in a round knob. A boy waits at the foot of the tree, and when the birds come at sunrise, and a sufficient number have assembled, and have begun to dance, the hunter shoots with his blunt arrow so strongly as to stun the bird, which drops down, and is secured and killed by the boy without its plumage being injured by a drop of blood. The rest take no notice, and fall one after another till some of them take the alarm. The native mode of preserving them is to cut off the wings and feet, and then skin the body up to the beak, taking out the skull. A stout stick is then run up through the specimen, coming out at the mouth. Round this some leaves are stuffed, and the whole is wrapped up in a palm spattie and dried in the smoky hut. By this plan the head, which is really large, is shrunk up almost to nothing, the body is much reduced and shortened, and the greatest prominence is given to the flowing plumage. Some of these native skins are very clean, and often have wings and feet left on; others are dreadfully stained with smoke; and all give a most erroneous idea of the proportions of the living bird. The Great Bird of Paradise, as far as we have any certain knowledge, is confined to the mainland of the Aru islands, never being found in the smaller islands which surround the central mass. It is certainly not found in any of the parts of New Guinea visited by the Malay and Bugis traders, nor in any of the other islands where Birds of Paradise are obtained. But this is by no means conclusive evidence, for it is only in certain localities that the natives prepare skins, and in other places the same birds may be abundant without ever becoming known. It is, therefore, quite possible that this species may inhabit the great southern mass of New Guinea, from which Aru has been separated."

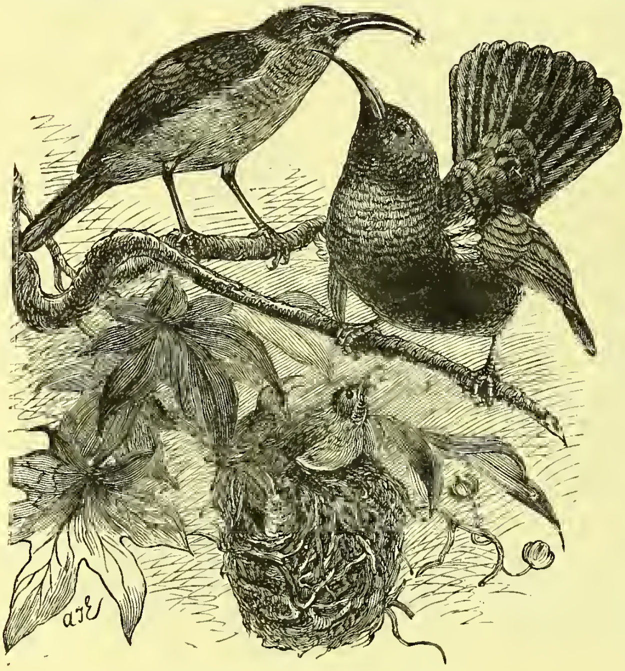
Another exquisite bird has been called after Mr. Wallace, by Mr. G. R. Gray. The Standard Wing (*Semioptera wallacei*) is an entirely new form of Bird of Paradise, discovered by Wallace in the island of Batchian, and especially distinguished by a pair of long narrow feathers of a white colour, which spring from among the short plumes which clothe the bend of the wing, and are capable of being erected at pleasure. The general colour of this bird is a delicate olive-brown, deepening to a kind of bronzy olive in the middle of the back, and changing to a delicate ashy-violet, with a metallic gloss on the crown of the head. The feathers, which cover the nostrils and extend half-way down the beak, are loose and curved upwards. Beneath it is much more beautiful. The scale-like feathers of the breast are margined with rich metallic blue-green, which colour entirely covers the throat and sides of the neck, as well as the long pointed plumes which spring from the sides of the breast, and extend nearly as far as the end of the wings. The most curious feature of the bird, however, and one altogether unique in the whole class, is found in the pair of long, narrow, delicate feathers which spring from each wing close to the bend. On lifting the wing-coverts they are seen to arise from two tubular horny sheaths, which diverge from near the point of junction of the carpal bones; they are erectile, and when the bird is excited are spread out at right angles to the wing and slightly divergent. They are from six to six inches and a half long, the upper one slightly exceeding the lower. The total length of the bird is eleven inches. The bill is horny olive, the iris deep olive, and the feet bright orange. The female bird is remarkably plain, being entirely of a dull, pale, earthy-brown, with only a slight tinge of ashy-violet on the head to relieve its general monotony; and the young males exactly resemble her. This bird frequents the lower trees of the forests, and, like most Paradise birds, is in constant motion—flying from branch to branch, clinging to the twigs, and even to the smooth and vertical trunks, almost as easily as a woodpecker. It continually utters a harsh, creaking note, somewhat intermediate between that of Paradisea apoda and the more musical cry of Cicinnurus regius. The males, at short intervals, open and flutter their wings, erect the long shoulder feathers, and spread out the elegant green breast shields. The



THE SATIN BOWER BIRD (*Ptilonorhynchus holosericeus*).

Standard Wing is found in Gilolo as well as in Batchian, and all the specimens from the former island have the green breast shield rather longer, the crown of the head darker violet, and the lower parts of the body rather more strongly scaled with green. This is the only Paradise bird yet found in the Moluccan district, all the others being confined to the Papuan Islands and North Australia.

Of the Bower Birds, we can only mention the Satin Bower Bird of Eastern Australia (*Ptilonorhynchus holosericeus*). Mr. Gould tells us that "On visiting the Cedar Brushes of the Liverpool range, I discovered several of these bowers, or playing-places. They are usually placed under the shelter of the branches of some overhanging tree in the most retired part of the forest; they differ considerably in size, some being larger while others are much smaller. The base consists of an exterior and rather convex platform, on which it is placed and with which it is interwoven; it is formed of sticks and twigs, but of a more slender and flexible description, the tips of the twigs being so arranged as to curve inwards and nearly meet at the top. In the interior of the bower the materials are so placed that the forks of the twigs are always presented outwards, by which arrangement not the slightest obstruction is offered to the passage of the birds.



JERICHO SUN BIRDS (*Cinnyris osea*).

"For what purpose these curious bowers are made is not yet, perhaps, fully understood; they are certainly not used as a nest, but as a place of resort for many individuals of both sexes, who, when there assembled, run through and round the bower in a sportive and playful manner, and that so frequently that it is seldom entirely deserted.

"The interest of this curious bower is much enhanced by the manner in which it is decorated, at and near the entrance, with the most gaily-coloured articles that can be collected. The propensity of these birds to fly off with any attractive object is so well known that the blacks always search the runs for any missing article." And equally interesting are the habits of the Spotted Bower Bird (*Chlamydera maculata*).

The Honey Suckers, or Meliphagidæ, form an extensive group, found chiefly in the Malay and Australian regions.

The Sun Birds, or Nectariniadæ, are to the Old World what the Humming Birds are to the New World. Their plumage often reflects quite a metallic lustre, and they are met with only in the tropical regions, but one species is met so far north as the Jordan valley in the Holy Land, called the Jericho Sun Bird (*Cinnyris osea*).

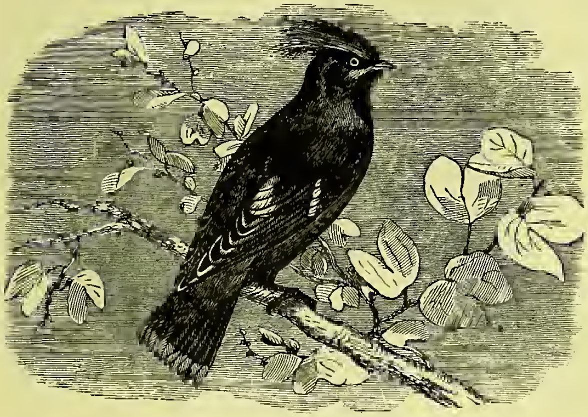
II.—THE TANAGROID PERCHERS.

This is the next largest division of the Passeres, containing nearly 1,400 species of birds, placed in some two hundred genera. Among such a number it is hard to choose. Some of the families have a very limited geographical distribution: thus, the Drepanidæ are limited to the Sandwich Islands; the Manakins, or Pipridæ, to the tropical regions of South America; the American Creepers, or Dendrocolaptidæ, and the Ant-Thrushes, or Formicaridæ, are also confined to America; while the larks, wagtails, and finches, have an immense area of distribution; and the swallows are true cosmopolites.

The Flower Peckers, or Dicæidæ, are not found in America. Of one of these (*Dicæum* *hirundinaceum*), Mr. Gould tells us that he frequently saw it flitting about the branches of a remarkably beautiful parasitic plant (Loranthus), which it seems to visit either to eat the soft viscid berries, or for the purpose of preying upon the little insects that come to feed on the flowers.

The Wood Warblers, or Mniotiltidæ, range over all North America, and to the tropics in the South. The Sugar-birds, or Cerebidæ, are confined to the tropical parts of America. The Greenlets, or Vireonidæ, are small fly-catching birds, peculiarly American.

Of the Ampelidæ, one representative is to be met with in Europe; the rest are American. This species is the Bohemian Wax-wing (*Ampelis garrula*). The name of this bird, as associating it with Bohemia in particular, is not strictly accurate, for in the central and southern parts of the European continent it is only, as it is in England, an accidental visitor in winter. Still, it has a very extensive geographical range east and west. Of these birds, the Prince of Canino says, "It seems probable that their chief place of abode is the Oriental parts of the old continent; and if we may hazard an opinion, we should not be surprised if the extensive and elevated table-land of Central Asia were found to be their principal rendezvous, from whence, like the Tartars in former times, they make their irregular excursions."


THE WAX-WING (*Ampelis garrula*).

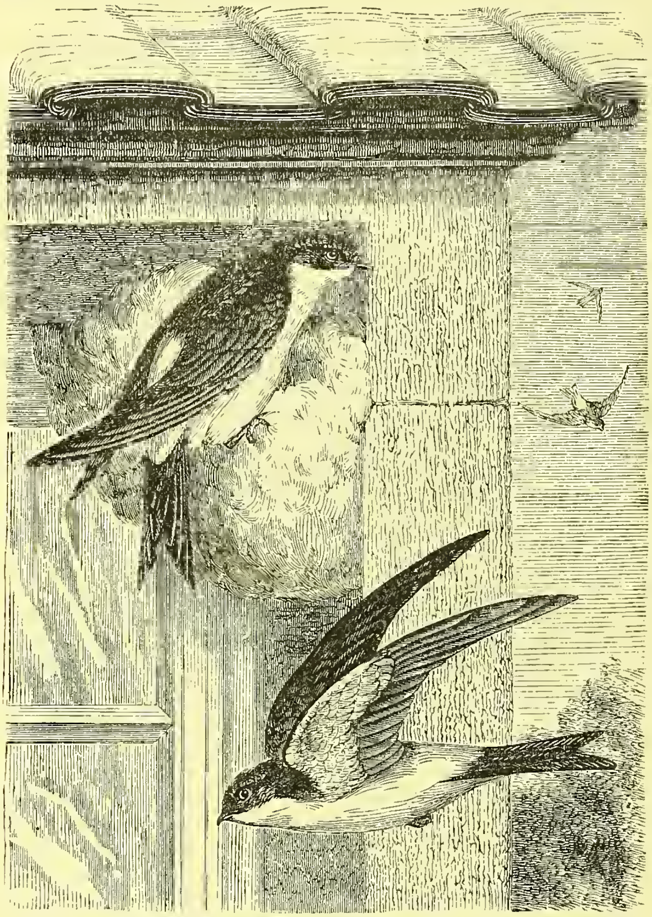
This bird has been met with frequently in Scotland, and yet at such irregular and often distant periods that it must be considered there a very rare bird. In England, if we except the northern counties, it is of still less frequent occurrence, although specimens have been obtained as far south as Devonshire and Cornwall. It is of active habits, but generally shy and easily put to flight. It is said to feed, not only on the berries of the ivy, rowan, whitethorn, and wild rose, but also on insects, which it pursues in the same manner as shrikes and fly-catchers, though not with equal dexterity.

The True Swallows, or Hirundinidæ, form a well-known family, some species of which are even found within the Arctic Circle. The Common Swallow (*Hirundo rustica*) is found in Europe, Asia, Africa, and from Lapland to the Cape of Good Hope. The flight of this bird is very rapid and graceful, and is readily distinguished from that of the swift by certain peculiarities, which are not easy to be described, but can be recognised without difficulty. Unlike the swift, which never settles except on some elevated spot, the swallow is fond of resting awhile on the ground, and may often be seen dusting itself after the fashion of a common sparrow. We have often seen it settle on the patches of sand that are left among the rocks at low water, and from the busy activity which it displayed on such occasions imagine it to have been engaged in chasing the sand-flies, or perhaps even the sand-hoppers that swarm so abundantly in such localities. The voice of the swallow is, although weak and twittering, very musical in its tone and pleasing to the ear.

The nest of the swallow is always placed in some locality where it is effectually sheltered from the rain and wind. Generally it is constructed under the eaves of houses; but as it is frequently built within disused chimneys, it has given to the species the popular title of Chimney Swallows. The bird is probably attracted to the chimney by the warmth of some neighbouring fire.

The nest is composed externally of mud or clay, which is brought by the bird in small lumps, and stuck in irregular rows so as to build up the sides of its little edifice. There is an attempt at smoothing the surface of the nest, but each lump of clay is easily distinguishable on the spot where it has been stuck. While engaged at the commencement of its labours the swallow clings perpendicularly to the wall of the house or chimney, clinging with its sharp little claws to any small projection, and sticking itself by the pressure of its tail against the wall. The interior of the nest is lined with grasses and other soft substances, and after it has been inhabited by a young brood becomes very offensive to the nostrils and unpleasant to the touch, in consequence of the large parasitic ticks which are peculiar to the birds of this tribe, and which swarm in the nest.

There are sometimes two broods in the year, and when the second brood has been hatched at a very late period of the year, the young are frequently deserted and left to starve by their parents, who are unable to resist the innate impulse that urges them to seek a warmer climate. It has occasionally, but very rarely, happened that the parents have remained for some time in order to bring up their second brood. When fully fledged, and before they are forced to migrate, the young birds generally roost for the night in osiers and other water-loving trees.


THE HOUSE MARTIN (*Chelidon urbica*).

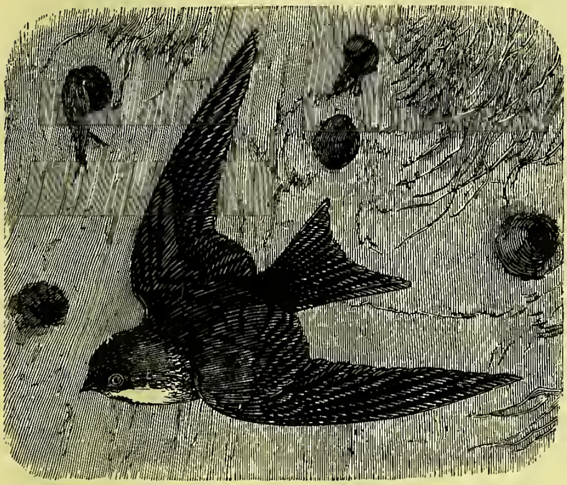
The swallow knows not the existence of frost nor the extreme of heat, passing from Europe to Africa as soon as the cold weather begins to draw in, and migrating again to the cool climes as soon as the temperature of its second home becomes inconvenient to its pleasant existence. The time of its arrival in England is various, and depends almost entirely on the state of the weather. Solitary individuals are now and then seen in very early spring, but as a general fact the swallow does not arrive until the second week in April; the time of its departure is generally about the middle of September. The House Martin differs from the Swallow in having a conspicuous white patch above its tail, which latter is not so well forked.

The Sand Martins (*Cotyle riparia*) dig for themselves in the banks of rivers and in the perpendicular sides of sand-pits round and regular holes, about two feet in depth, which run horizontally and in a somewhat serpentine direction; but they often take advantage of holes already made. At the farther end of these burrows they construct a rude nest of grass and feathers.

"Though no one," says Gilbert White, "would be inclined to believe that this weak bird, with her soft tender bill and claws, should ever be able to bore the stubborn sand-bank without entirely disabling herself, yet, with these feeble instruments, have I seen a pair of them make great despatch, and could remark how much they scooped in a day by the fresh sand which ran down the bank, and which was of a different colour from what lay loose and had been bleached by the sun. In what space of time these little artists are able to mine and finish these cavities I have never been able to discover, but it would be a matter worthy of observation where it falls in the way of any naturalist to make such remarks.

"This I have often taken notice of: that several holes of different depths are left unfinished at the end of the summer. To imagine that these beginnings were intentionally made in order to be in the greater forwardness for the ensuing spring is, perhaps, allowing too much foresight to a simple bird. May not the cause of these being left unfinished arise from the birds meeting in those places with strata too hard, harsh, and solid for their purpose, which they relinquish, and go to a fresh spot that works more freely? Or may they not in other places fall in with a soil as much too loose and mouldering, liable to flounder, and threatening to overwhelm them and their labours? One thing is remarkable—that after some years the old holes are forsaken and new ones bored, perhaps because the former habitations were become foul and fetid from long use, or because they so abounded with fleas as to become untenable."

The AMERICAN HANG-NESTS, OR ICTERIDÆ, range over the whole of America, even up to the Arctic Circle. The Great Boat Bill (*Quiscalus major*) is found in the Southern states. It is often called there the jackdaw; it is a bird abounding on the sea-shore, and is migratory. The Purple Grakle (*Q. versicolor*) is also another very common American bird, often very destructive to the farmer. It often builds its nest amid the twigs which form the foundation of the large nest of the fish-hawk.



THE SAND MARTIN (*Cotyle riparia*).

The Orchard Oriole (*Xanthornis varius*) constructs a wonderful nest. It is formed externally of a particular species of long, tough, and flexible grass, knit or sewed through and through in a thousand directions as if actually done with a needle. The nest is hemispherical, three inches deep by four in breadth, the concavity scarcely two inches deep by two in diameter. I had the curiosity to detach one of the fibres or stalks of dried grass from the nest, and found it to measure thirteen inches in length, and in that distance it was thirty-four times hooked through and returned winding round and round the nest. The inside is usually composed of the light downy appendage attached to seeds of the button-wood, which forms a very soft and commodious bed. Here and there the outward work is extended to an adjoining twig, round which it is strongly twisted, to give more stability to the whole, and prevent it from being overset by the wind. When they choose the long pendant branches of the weeping willow to build in, as they frequently do, the nest, though formed of the same materials, is made much deeper and of lighter texture. The circumference is marked out by a number of these pensile twigs, that descend on each other like ribs, supporting the whole, their thick foliage at the same time completely concealing the nest from view. These large pendant branches, being sometimes twelve and even fifteen feet in length, have a large sweep in the wind, and render the first of these precautions necessary to prevent the eggs or young from being thrown out; and the close shelter afforded by the remarkable thickness of the foliage is, no doubt, the cause of the latter.

The orchard oriole is a lively, active, restless bird, never idle, never inanimate, but perpetually on the alert, his shrill and rapid carol being maintained with little intermission. He is very destructive among the insects and caterpillars which infest the leaves and buds of fruit-trees, thereby rendering man no little service: for hundreds of these pests to the farmer are not sufficient for the daily consumption for himself, his mate, and their young. The multitudes thus destroyed by a single pair of birds must be prodigious.

The Cow Bunting of America (*Molothrus pecoris*) is noted for the following trait:—"When," says Nuttall, "the female is disposed to lay, she appears restless and dejected, and separates from the unregarding flock. Stealing through woods and thickets she prys into the bushes and branches for the nest that suits her, into which she darts in the absence of the owner, and in a few minutes is seen to rise on the wing, cheerful, and relieved from the anxiety that oppressed her, and proceeds back to the flock she had so reluctantly forsaken. If the egg be deposited in the nest alone it is uniformly forsaken, but if the nursing parent has any of her own she immediately begins to sit. The red-eyed fly-catcher, in whose beautiful basket-like nest I have observed these eggs, proves a very affectionate and assiduous mother to the uncouth foundling. In one of these I found an egg of each bird, and the hen already sitting. I took her own egg and left the strange one. She soon returned, and, as if sensible of what had happened, looked with steadfast attention, and shifted the egg about, then sat upon it, but soon moved off; again renewed her observation, and it was a considerable time before she seemed willing to take her seat; but at length I left her on the nest. Two or three days after I found she had relinquished her attention to the strange egg, and had forsaken the premises. Another of these birds, however, forsook the nest on taking out the cow-bird's egg, although she had two of her own left. The only example, perhaps, to the contrary of deserting the nest when solely occupied by the stray egg is in the blue-bird, who, attached strongly to the breeding places in which it often continues for several years, has been known to lay after the deposition of the cow-bird's egg."

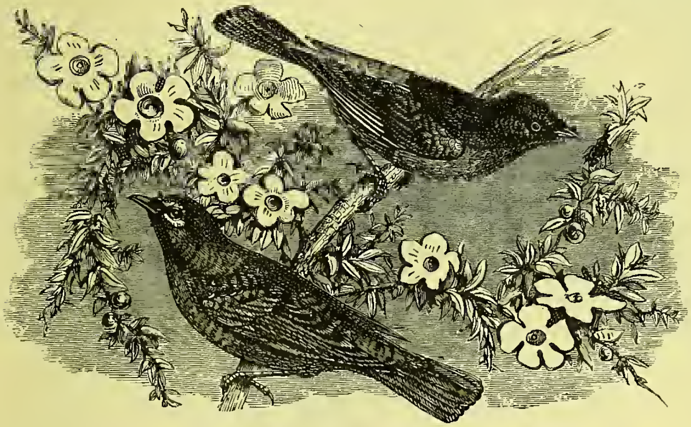
RED-WINGED STARLING (*Agelaius phœniceus*).

The Red-winged Starling (*Agelaius phœniceus*) is a gregarious bird. The aerial evolutions of a large number of these birds is very curious. Sometimes they appear like a large black cloud driving before the wind, varying its shape every moment; sometimes rising suddenly from the fields with a noise said to resemble thunder, while the glittering of innumerable wings of the brightest vermilion amid the black cloud they form produces on such occasions a very splendid effect. Then descending like a torrent, and covering the branches of some detached grove or clump of trees, the whole congregated multitude will commence a general concert or chorus, which may sometimes be distinguished at the distance of more than two miles, and which, if heard at an interval of about a quarter of a mile, with a slight breeze to swell and soften, the flow of the cadence is stated to be grand, if not sublime. The entire winter season, which with most birds is spent in struggling to maintain life in silent melancholy, is with the red-wing a continual carnival, for as soon as the profuse gleanings of the old rice, corn, and buck-wheat fields have supplied them with food, of which there is abundance, they rise to their aerial manœuvres, or to rehearse their grand vocal entertainments. About the middle of March they begin to enter Pennsylvania. They appear in small but numerous parties, and from daybreak to eight or nine o'clock in the evening chattering to each other as they fly along; and despite the destructive character of their visit, their presence gives cheerful promise of returning spring and beauty. They select their old haunts, preferring meadows, creeks, swamps, and ponds, till about the middle of April, when they separate into pairs, and in two or three weeks begin to build their nests. A favourite spot for this purpose is a thicket of alder-bushes, a detached bush in a meadow of high grass, or a tuft of rank rushes or grass: especial regard being paid to such neighbourhoods as have swamps, meadows, or other watering-places.

When the nest is built in a bush, it is generally composed outwardly of wet rushes picked from the swamp, and long tough grass in large quantities, the whole being lined with very fine bent. The rushes forming the exterior are generally extended to several of the adjoining twigs, round which they are repeatedly and securely twisted, an indispensable precaution, on account of the flexible nature of the bushes in which it is placed. The same precaution is observed when a tuft of grass or rushes is selected, the tops being fastened together and intertwined with the materials of which the nest is formed, with the stalks of rushes around. When placed upon the ground, less care and fewer materials are necessary. It is not uncommon to find several nests in the same thicket within a few feet of each other.

As is the case with most other birds which build in low situations, the males exhibit the most violent apprehension on the approach of an intruder; and this is especially the case after the young are hatched. Like the lapwings of Europe, they fly to meet the invader, hovering at a slight elevation above him, and uttering loud cries of distress; and while in this position displaying to great advantage the rich glowing scarlet of their wings, which is heightened by the jetty-black of their plumage.

The Tanagers, or Tanagridæ, form a well-marked family, typical of this division of the perching-birds. They are among the most beautifully coloured of the group. Nearly all are inhabitants of America; some few extend to the West Indian Islands. The Scarlet Tanager (*Pyranya rubra*) is a handsome bird of a fine scarlet body, with black wings and tail. It is possessed of some musical power. "Among all other birds," says Wilson, "that inhabit our woods, there is none that strikes the eye of a stranger, or even a native, with so much brilliancy as this. Seen among the green leaves, with the light falling strongly on his plumage, he really appears beautiful. If he has little melody in his notes to charm us, he has nothing in them to disgust. His manners are modest, easy, and inoffensive; he commits no depredations on the property of the husbandman, but rather benefits him by the daily destruction in spring of many noxious insects; and when winter approaches, he is no plundering dependant, but seeks in a distant country for that sustenance which the severity of the season denies to his industry in this. He is a striking ornament to our rural scenery, and none of the meanest of our rural songsters. Such being the true traits of his character, we shall always with pleasure welcome this beautiful, inoffensive stranger to our orchards, groves, and forests."


THE SCARLET TANAGER (*Pyranga rubra*).

The Organist Tanager (*Euphonia musica*) derives its popular name from its fine rich notes.

The great family of the Finches, or Fringillidæ, would itself require a whole volume. Some would separate the buntings from the finches; here we will, to save space, take both in one, commencing with the genus Fringilla. We find here some of the best known British birds. The Chaffinch (*Fringilla cœlebs*), it is generally known, is famed for the sprightliness of its warbling, and is a favourite bird with most of our bird-fanciers. The passion for this bird is carried to such an extent in Thuringia, and those that sing well are so much sought after, that scarcely a chaffinch that warbles tolerably can be found throughout the province. As soon as one arrives from the neighbouring country whose notes appear good, all the bird-catchers seek it, and do not give up the pursuit until they have taken it. Linnæus gave the name of cælebs, or bachelor, to the chaffinch, because he thought that the females alone migrated from Sweden in winter, leaving their husbands in a bachelor state behind them.

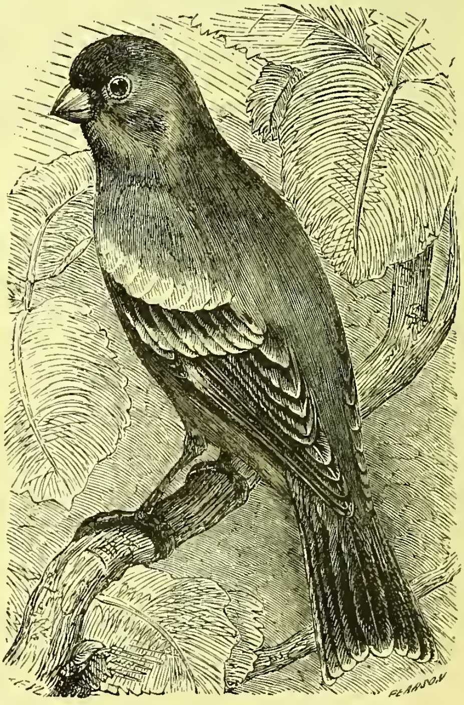
The Goldfinch (*F. carduelis*) is pleasing from its gay attire and lively habits; its cheerful song, and strong disposition to personal attachment, renders this one of the most favourite cage-birds. Well, too, do the goldfinches bear confinement, living as they have done ten years in captivity, and singing the greater part of each year.

The Siskin (*F. spinus*) is smaller than the goldfinch, and in appearance not so firm and compact. Its prominent colours are black, bright-yellow, sulphur-yellow, and a peculiar sort of green approaching to sage-green, but so peculiar as to give rise to the name of "siskin-green." The bill is not by any means so powerful as that of the goldfinch, and the bird altogether more resembles the canary, except in colour and being smaller.

The Greenfinch (*F. chloris*) has a thicker and more convex bill than that of the sparrow, and much less conical than that of the finches; but more nearly resembles the finches than the sparrows. The upper part of this bird is olive-green, rather warm and bright in the tint, passing into a yellowish hue, and relieved by grey on the margins of some of the feathers; the top of the head is of a rather browner green than the back; the breast of a greyish-yellow; the lower parts and under tail-coverts the same. The female has the green and yellow less bright, and is altogether of a browner tint than the male.

THE GOLDFINCH (*Fringilla carduelis*).

The Common Linnet (*F. cannabina*) is very common in Britain, and extends as far as the Orkneys, where it is abundant. During the summer it resorts to waste lands and commons in the higher parts of the country, where it breeds. Furzy commons seem to be favourite resorts of these birds during that season, the bushy furze being admirably adapted to conceal the nest from the prying eye; and sometimes a quickset or gooseberry-bush answers the purpose. The nest is composed of moss and woven wool, and lined with wool and hair very neatly put together; there are four eggs, of a bluish-white, with a few purplish specks and short lines. If the nest should be destroyed they will build another as late as the month of August.



THE CHAFFINCH (*Fringilla cœlebs*).

The Canary Bird (*Carduelis canaria*) had its origin in the pleasant climate and delightful valleys of the Canary Islands, and is now spread throughout Europe and part of Asia. The beauty of its form, its plumage, and its song, united with its general docility, soon gained it admittance into the most magnificent abodes, where so many delight in rearing and preserving it, whilst the fairest hands are often eager to present it with the most delicate food.

The arrival of the canary in Europe about the beginning of the sixteenth century is thus described:—A vessel which, besides its merchandise, was bringing a number of these birds to Leghorn, was ship-wrecked on the coast of Italy, opposite the island of Elba, where these little birds, having been set at liberty, took refuge. The climate being favourable, they increased, and would certainly have become naturalised, had not the wish to possess them occasioned their being caught in such numbers, that at last they were extirpated from their new country. From this cause, Italy was the first European country where the canary was reared. At first their education was difficult, as the proper manner of treating them was unknown; and what tended to render them scarce was that mostly male birds were brought over; there were but few females. The original colour of the canary was grey, inclining to green on the under part of the body, and, on the whole, not unlike that of the linnet. But this has undergone so complete a change, from domestication, difference of climate, and by hybridising with birds allied in species, that we now have canaries of almost every colour. The prevailing hues, however, are grey, yellow, white, blackish, and reddish-brown; the mixture of which again gives rise to innumerable varieties. In Italy the canary has bred chiefly with the citron-finch and the serin; in northern Europe with the linnet, greenfinch, and siskin. "Were it not, indeed," says Bechstein, "a well-established fact, that the canary is a native of the islands of the same name, we might reasonably suppose that it descended from some one or more of the species above mentioned. I have seen a mule, between a siskin and a serin, which exactly resembled a green canary, and also the offspring of a female grey canary, in which no trace of their real parentage was discernible."

THE CANARY (*Carduelis canaria*).

The Cardinal Grosbeak of America (*Cardinalis virginianus*) is a bird somewhat larger than the hawfinch, but of far more gorgeous colours, being scarlet and black, with a crest.

The Hawfinch (*Coccothraustes vulgaris*), despite its Latin name, cannot be regarded as very common in Great Britain. It is a gregarious bird, and may still be seen in Epping Forest, but it is an extremely watchful bird.

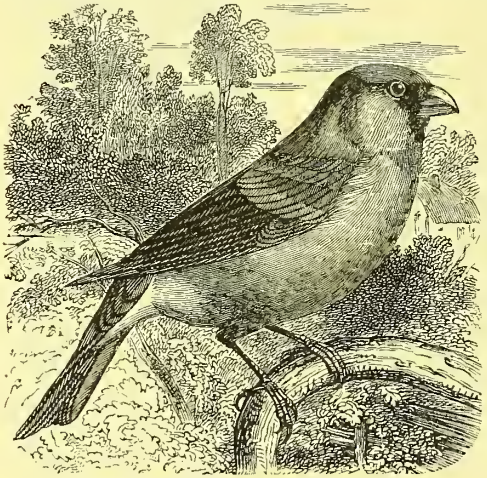
The Bullfinch (*Pyrrhula rubicilla*) is found in most parts of Europe, frequenting woods and gardens. It builds its nest either in the fork of a tree, not very high, or in a bush, generally the white-thorn. About the end of April, or in May, these birds commence to build their nests. The nest is composed of small branches interlaced on the outside, and the fibres of roots within. The female lays from four to six bluish-white eggs, with red or brownish spots, particularly towards the greater end. Besides the buds of trees, on which these birds feed, they take also in summer grain and berries, and it has been said sometimes insects.

THE LINNET (*Fringilla cannabina*).

This species, which possesses many pleasing qualities when caged, is very destructive in a state of nature, by feeding on the buds of fruit-trees, especially pears, apples, and plums. They appear to associate in families: the parents and their young of the same season, an association not put an end to by the approach of winter, but which continues until the ensuing spring, when the young pair mate and breed. A woody country in the vicinity of hills is their favourite resort. They are usually seen on the upper branches of trees; but should a hawk or anything else alarm them, they descend rapidly into the middle of the thickest bush at hand, and remain there without uttering the slightest noise. In spring, on the contrary, when the family disperses, and the young males select their mates, they are no longer to be found on the tops of trees, but concealed in the closest bushes, where they would escape all observation, but for the continued call they make use of to one another.

The bullfinch is a very docile bird, and though the natural song of both sexes is harsh and disagreeable—resembling the creaking of a door or wheelbarrow—they may be trained, as in England, Germany, and Holland, to whistle many airs and songs, in a soft, pure, flute-like tone, which is highly prized by amateurs. The bird is generally capable of retaining in its memory three different tunes. Bullfinches are best instructed by a flute or the whistling of a teacher.

A great number of piping bullfinches are annually sent to this country, after going through the usual course of instruction. No school can be more diligently attended by its master, and no scholars more effectually trained to their own calling, than a seminary of bullfinches. As a general rule, they are formed into classes of about six in each, and kept in a dark room, when food and music are administered at the same time; so that when the meal is ended, if the birds feel disposed to tune up, they are naturally inclined to copy the sounds which are so familiar to them. As soon as they begin to imitate a few notes, the light is admitted into the room, which still further exhilarates their spirits and inclines them to sing. In some establishments the starving system is adopted, and the birds are not allowed food or light until they sing.



THE BULLFINCH (*Pyrrhula rubicilla*).

When they have been under this course of instruction for some time, they are committed singly to the care of boys, whose sole business is to go on with their education. Each boy assiduously plays his organ from morning till night for the instruction of the bird committed to his care, while the class-teacher goes his regular rounds, superintending the progress of his feathered pupils, and scolding or rewarding them in a manner which they perfectly understand, and strictly in accordance with the attention or disregard they have shown to the instructions of the monitor.

This round of teaching goes on unintermittingly for no less a period than nine months, by which time the bird has acquired the tunes, and is less likely to forget or spoil the air by leaving out passages or giving them in the wrong place. At the time of moulting the best instructed birds are liable to lose the recollection of their tunes, and therefore require to have them frequently repeated at that time, otherwise all the previous labour will be thrown away. There are celebrated schools for these birds at Hesse and Fulda, from whence all England, Germany, and Holland receive supplies of the little musicians.

The bullfinch may also be brought to articulate words; and the female is equally capable of this acquirement with the male. They show also more attachment than other small birds in general, and can distinguish strangers from those who have the care of them or are their teachers.

The Crossbill (*Loxia curvirostra*). "The beak of this bird," says Yarrell, "is altogether unique in its form; the mandibles do not lie upon each other, with their lateral edges in opposition, as in other birds, but curve to the right and left, and always in opposite directions to each other. In some specimens the upper mandible is turned to the right, the lower mandible curved to the left; in others, the position of the mandibles is reversed as to their direction. In the specimen I examined the upper mandible curved downwards and to the left, the under portion turned upwards and to the right. When holding the head of the bird in my fingers, I found I could bring the point of the under mandible in a line underneath, and touching the point of the upper, but not beyond it towards the left side, while on its own side the point passed with ease to the distance of three-eighths of an inch. The upper mandible has a limited degree of motion on the cranium, the superior maxillary and nasal bones being united to the frontal by flexible bony laminæ."

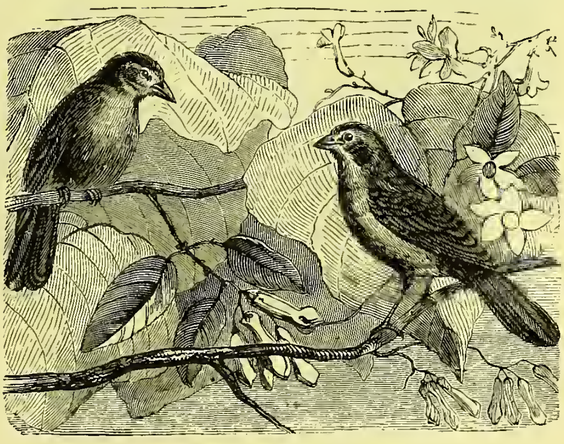
CROSSBILLS (*Loxia curvirostris*).

The great pine forests, such as the Hartz, in Germany, are the natural places of residence of the crossbills, and the seed of the cones of these trees are their food. It is also common in the north of Europe, where it breeds.

The Java Sparrow (*Padda oryxivora*). This bird is most frequently met with in the trees growing in New Holland, where the different species of banksia are found, the flowers of which probably afford it a sustenance during winter. In the summer it has been shot when sucking the flowers of *Leptospermum flavescens*. In the scrubs about Paramatta it is very common.

The Yellow Bunting (*Emberiza citrinella*) is a little bird which may be seen darting in spring and summer from the hedges, bushes, and copses it frequents, loving, as it does, the richer parts of the country. The fine lemon-yellow colour of the male's head and breast, and the rich chestnut and brown of the back, invest him indeed with a brilliant plumage. But to this his song is not equal, attracting no human ear; while so common is this beautiful bird, being indigenous to England, Wales, Ireland and Scotland, as often to be unnoticed when flying from one low tree to another, or from bush to bush, as the pedestrian proceeds on his way. The head of the female has much less yellow, and her general colour is inferior in vividness to that of the male.

The Ortolan (*E. hortulana*), or Garden Bunting, is widely celebrated for the delicacy of its flesh, or rather for that of its fat; the fat of the ortolan being somewhat analogous to the green fat of the turtle, in the opinion of gourmands. The ortolan has occasionally been shot in England, but it is most frequently found on the Continent, where its advent is expected with great anxiety, and vast numbers are annually captured for the table. These birds are not killed at once, as they would not be in proper condition; but they are placed in a dark room so as to prevent them from moving about, and are fed largely with oats and millet until they become mere lumps of fat, weighing nearly three ounces. The net and decoy-bird are the means that are generally employed for their capture.

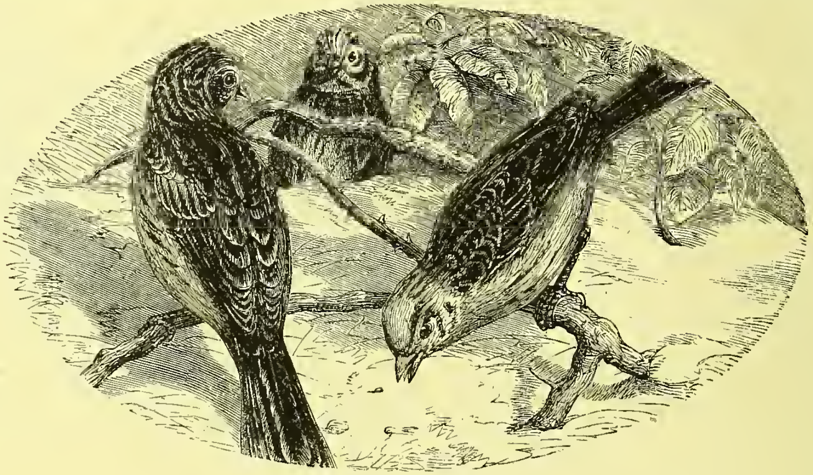


JAVA SPARROWS (*Padda orixivora*).

The Bunting (*E. miliaris*) is a very common British bird.

The Snow Bunting (*Plectrophanes nivalis*) inhabits, during the breeding season, the Arctic regions and the islands of the Polar Sea. In removing some drift timber lying on the beach of Cape Parry, Sir J. Richardson found a nest on the ground containing four young snow birds. The nest is composed of dry grass, neatly lined with deer's hair and a few feathers, and is generally fixed in the crevice of a rock, or in a loose pile of timber or stones. The eggs are a greenish-white, with a circle of irregular umber-brown spots round the thick end, and numerous blotches of subdued lavender-purple. Of the young discovered by Sir J. Richardson, he says:—"Care was taken not to injure them; and while we were seated at breakfast, at the distance of two or three feet, the parent birds made frequent visits to their offspring, at first timidly, but at length with the greatest confidence, and every time bringing grubs in their bill."

During the months of December and January, the snow bunting retires to the southward of the Saskatchewan. It usually reaches that river again about the middle of February; two months afterwards it attains the sixty-fifth parallel of latitude, and in the beginning of May it is found on the coast of the Polar Sea. At this period it feeds on the buds of the *Saxifraga oppositifolia*, one of the earliest of the Arctic plants; during the winter its crop is generally filled with grass seeds. In the month of October, Wilson found a large flock running over a bed of water-plants, and feeding, not only on their seeds, but on the shelly molluscs which adhered to the leaves; and he states that the long hind claws of these birds afford them much support when so engaged. The young are fed with insects.



BUNTINGS (*Emberiza miliaris*).

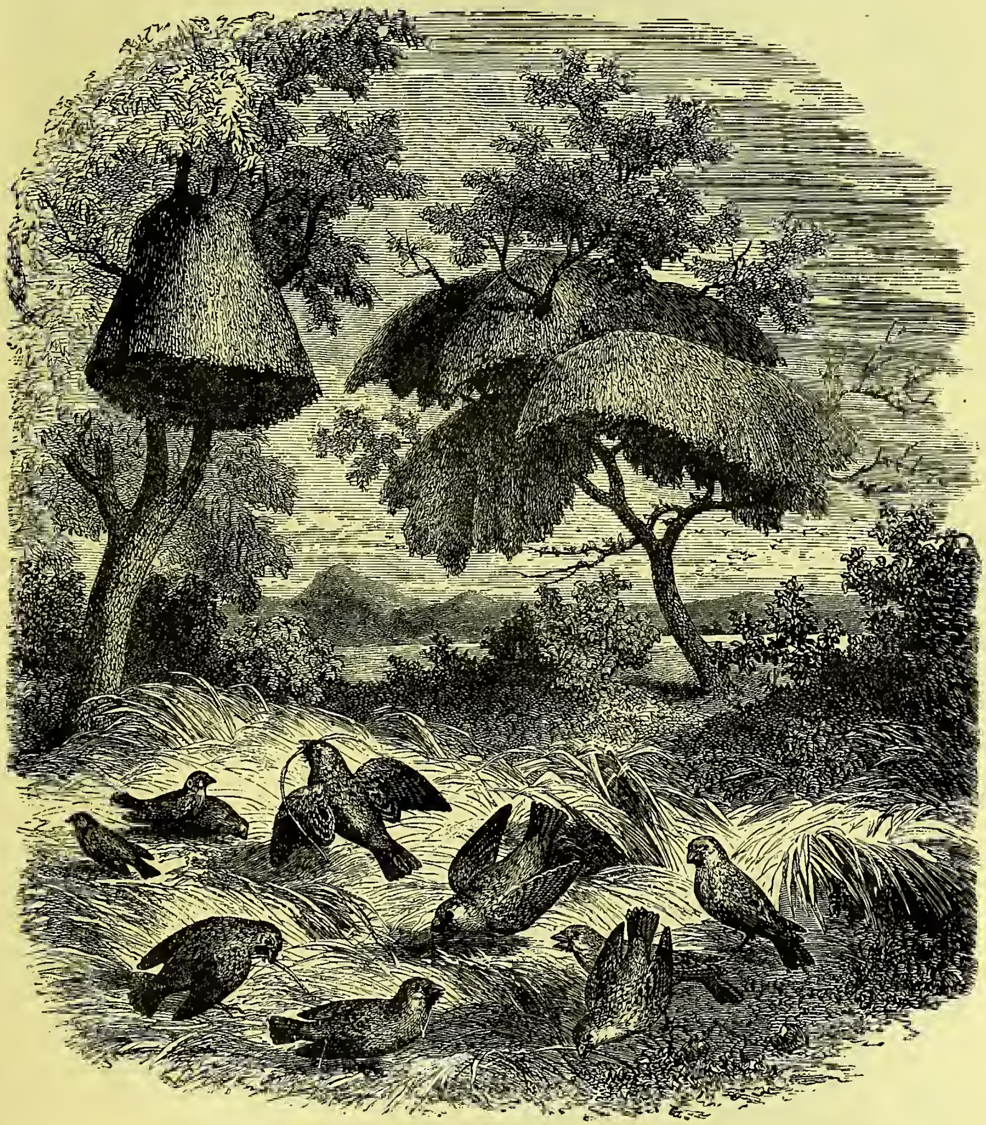
III.—THE STURNOID PERCHERS.

The birds belonging to this third section are almost exclusively natives of the Old World. There are not more than probably a thousand species included in this section by Mr. Wallace, and these embrace the starlings, larks, and wagtails.

The Weaver Birds, or Ploceidæ, are peculiarly African birds. The Mahali Weaver (*Ploceus taha*) is a social bird, feeding upon fruits and insects. Hanging from a single tree will often be seen twenty to thirty of these curious nests; these resemble large wine flasks. The Rice-eaters belonging to the genus Foudia are very common in Madagascar and the adjoining islands.

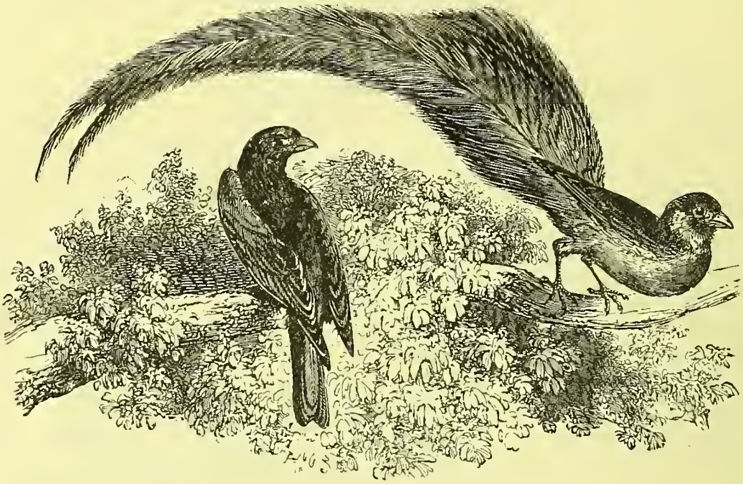
The Sociable Weaver Bird, or Philetærus socius, excels any of the feathered race in the extent of its habitation. Usually selecting a large and lofty tree, these birds find under its ample top and strong wide-spreading branches a good shelter and support for their erection. Having chosen the site, the framework is constructed by the combined efforts of the fraternity at large, who will derive from it a common advantage. The nest is firmly interwoven with the branches of the tree on which it rests, and often a large part of a principal branch is included within its substance. This part of the work being completed, each pair proceeds to the construction of its own nest, which, like the roof. consists of grass.

Le Vaillant, in his "Travels in Africa," says:—"I observed, on the way, a tree with an enormous nest of these birds, to which I have given the appellation of republicans; and, as soon as I arrived at my camp, I despatched a few men with a wagon to bring it to me, that I might open the hive and examine its structure in its minutest parts. When it arrived, I cut it to pieces with a hatchet, and saw that the chief portion of the structure consisted of a mass of Buchman's grass, without any mixture, but so compact and firmly basketed together as to be impenetrable to the rain. This is the commencement of the structure; and each bird builds its particular nest under this canopy, the upper surface remaining void, without, however, being useless; for as it has a projecting rim, and is a little inclined, it serves to let the rain-water run off, and preserve each little dwelling from the rain. Figure to yourself a huge, irregular, sloping roof, all the eaves of which are completely covered with nests crowded one against another, and you will have a tolerably accurate idea of these



THE SOCIABLE WEAVER BIRD (*Philetærus socius*).

singular edifices. Each individual nest is three or four inches in diameter, which is sufficient for the bird. But as they are all in contact with one another around the eaves, they appear to the eye to form but one building, and are distinguishable from each other only by a little external aperture which serves as an entrance to the nest; and even this is sometimes common to three different nests, one of which is situated at the bottom and the other two at the sides."



THE PARADISE WHIDAH BIRD (*Vidua paradisea*).

"The largest nest examined," says Patterson, "was one of the most considerable I had anywhere seen in the course of my journey, and contained three hundred and twenty inhabited cells; such a calculation, however, would not be exact." It appears that in every flock the females are more numerous by far than the males; many cells, therefore, would contain only a single bird.

The Paradise Whidah Bird (*Vidua paradisea*) is a species that is familiar in cages and menageries, as it is by no means an uncommon bird in its native land, and bears confinement better than most inhabitants of a tropical land. It is an inhabitant of Western Africa, being found throughout the whole district from Senegal to Angola; and as it is of a light and airy disposition, it gives a lively aspect to the trees among which it lives. It is perpetually in motion, flitting from bough to bough with graceful lightness, pecking here and there after a casual insect, and evidently admiring its own beautiful tail with thorough appreciation.

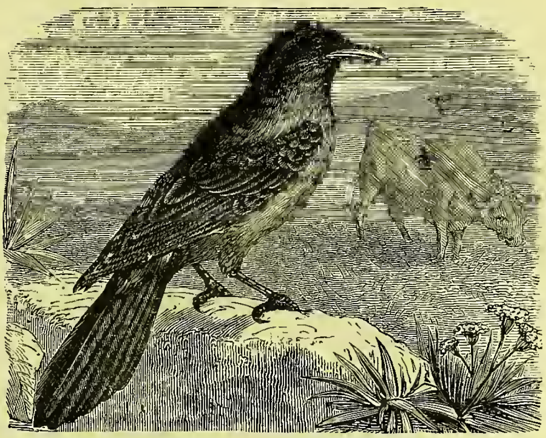
Another lovely species is the Shaft-tailed Whidah Bird (*Vidua regia*); here also belong the numerous species of the genera Estrelda and Amadina.

THE STARLING (*Sturnus vulgaris*).

The STARLINGS, OR STURNIDÆ, are a well-marked Old World group. No species of the family are found in Australia. The Rose Pastor (*Pastor roseus*) occurs in Europe, and extends to Ceylon and Burmah; it is very rarely met with in Great Britain. It is easily known by its delicate pink colour and long flowing crest of jet-black feathers.

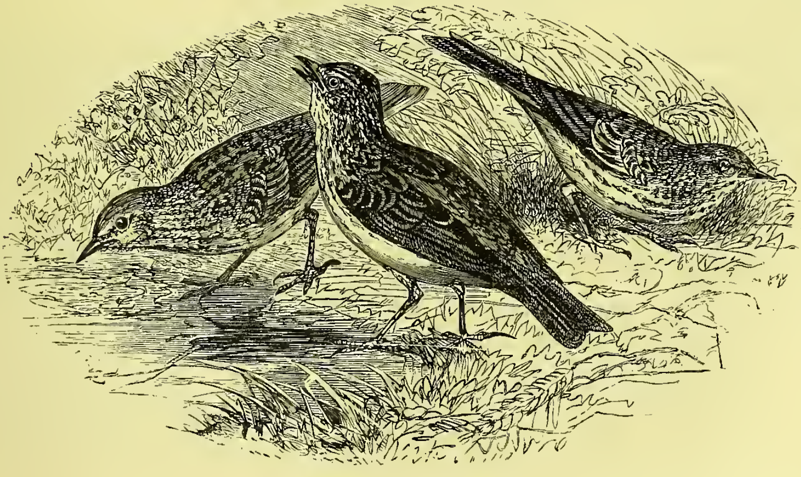
The Mynah (*Acridotheres tristes*) will be well known to all visitors to British India.

Its habits, so like that of our common starling, are even more familiar; and it is as great a robber as our magpie. Still, it is a cheery bird, and one is apt to forgive its impudence from its very audaciousness. Many amusing tricks are often taught to the mynah; and it possesses a talent for talking equal to that enjoyed by the magpie, the raven, the starling, or the parrot. So admirable a conversationalist is it, that some writers, who have had personal experience of its capabilities, think that it surpasses even the grey parrot in its power of imitating the human voice. It will repeat many words with extraordinary accuracy, and some specimens have learned phrases and sentences of considerable length.


THE AFRICAN BEEFEATER (*Buphaga africana*).

The Common Starling (*Sturnus vulgaris*) is one of our handsomest native birds. It is of a blackish hue, changing to purple towards the front of the body, and to green towards the hind part and on the wing-coverts; the quill-feathers, and under the neck, are reddish-white, those of the back, light rust-red; the tips of the head-feathers and under the neck are reddish-white, those of the back, light rust-red; and those of the under part of the body whitish, which gives the bird a speckled appearance. It is often seen, especially in spring, on towers, steeples, and churches; but it is never found either on high mountains or ridges. In Britain, it often departs in October in great flights for the south, and returns in like manner in the beginning of March.

The African Beefeater (*Buphaga africana*) haunts the spots where cattle are kept, alighting upon their backs, and setting vigorously to work in digging from beneath their skins the larvæ of the bot-flies which burrow beneath the hide, and which may often be seen on the backs of our English cattle by means of the little hillock of skin which they raise. To extract these deeply-buried creatures would seem to be a matter of considerable difficulty; but the beefeater manages the matter easily enough, by fixing itself tightly on the animal's back by means of its extremely powerful claws, and working with its strong and oddly-shaped beak. Other animals beside oxen are subject to the attacks of these insect foes,


LARKS (*Aluada arvensis*).

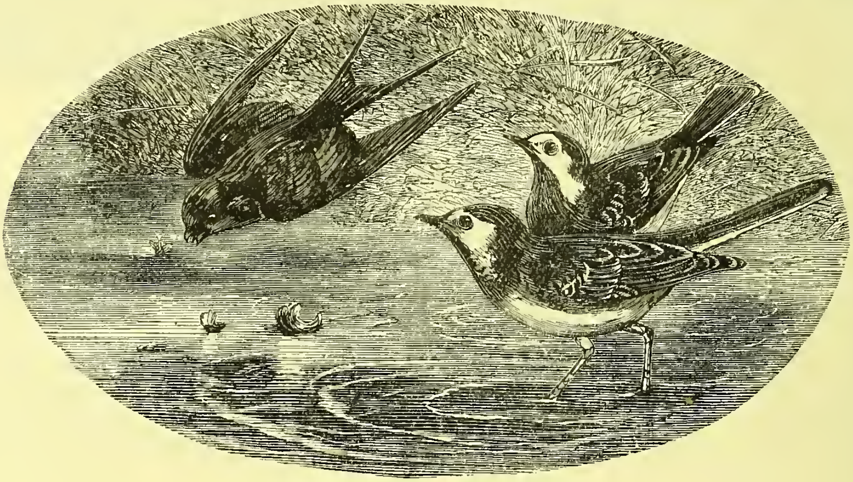
and are equally visited by the beefeater, who pursues his beneficial avocation without the least opposition on the part of the suffering animal.

The Larks, or Alaudidæ, form an easily recognised family. The species are very numerous in Southern Africa, and only two are to be met with in America.

The Common Skylark (*Alauda arvensis*) is universally distributed over the British Islands. It is said to be only a summer visitor to Orkney and Shetland, as it is to Denmark, Sweden, and Norway. Over the whole of the European continent, down to the Mediterranean, it is a common bird. The skylark pairs in April, and constructs its nest of withered grass. Some sheltered spot is chosen; and a curious instance is related of an attempt on the part of a female bird, who had built her nest among some tall grass, to reproduce the shelter artificially when the field was mown for hay.

The Wagtails, or Motacillidæ, including in this family the Pipits (*Anthus*), are a well-marked and widely-diffused family.

The Pied Wagtail (*Motacilla yarrellii*) remains in England throughout the year, but generally retires to the southern counties during the winter, as it would otherwise be unable to obtain its food. Sometimes, however, where the springs are so copious that the water never entirely freezes, the wagtail may be seen haunting its accustomed spot, and drawing a subsistence from the unfrozen waters. The more northern coasts are a favourite resort of the wagtails, which run briskly along the edge of the advancing or receding tide, picking up any stray provender that may come within their reach.

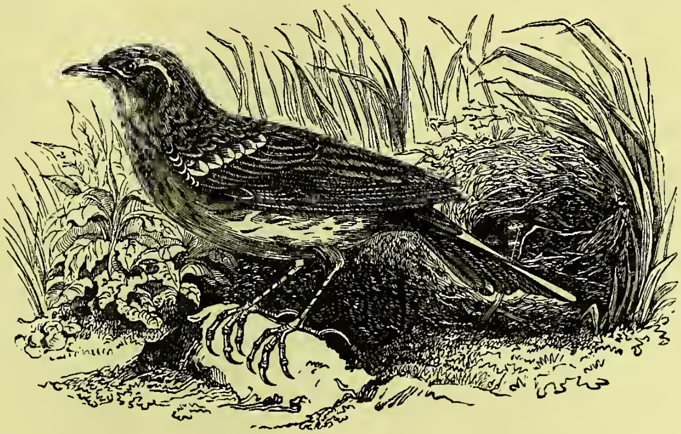


GREY WAGTAILS (*Motacilla campestris*).

The song of the pied wagtail is soft, low, and sweet, and is generally uttered in the early morning from the elevation of some lofty spot, such as the summit of a pointed rock, the roof of an out-house, or the top of a paling. The bird is bold and familiar, coming quite close to human beings without displaying any fear, and even following the ploughman for the purpose of picking up the grubs and insects that are turned out of the soil by the share.

The Grey Wagtail (*Motacilla campestris*). Of the nesting of this species, Mr. Thompson speaks as follows:—“ The situations generally selected for the nest are holes in walls, the preference being given to those of bridges, about mill-wheels, or otherwise contiguous to water. In the romantic glens of the Belfast mountains they also build, and for this purpose, a pair generally resort to a fissure in the rock, beside a picturesque cascade of ‘the Falls:’ just such a place as would be chosen by the water-ousel. On the 18th of March, a pair of grey wagtails, ‘with black patch on throat,’ have been noted, apparently contemplating nidification, at Wolf Hill, by minutely examining their former breeding haunts; and on the 12th of May the young of the first brood were seen on the wing, though still requiring their parents' aid to feed them. Occasionally there is a second brood. The nest is generally formed of grasses or other delicate plants, and lined with horsehair. It is singular that they generally manage to pick up enough of this last material for lining.

Four nests at Wolf Hill in one season were all lined with it; the eggs were usually four in number; and during incubation, the beautiful and minute bird would admit of close approach. Throughout the winter, the grey wagtails generally keep in pairs; in autumn only have I seen a whole family, and never more together. They may then be seen roosting in company at the base of trees or underwood overhanging the water."



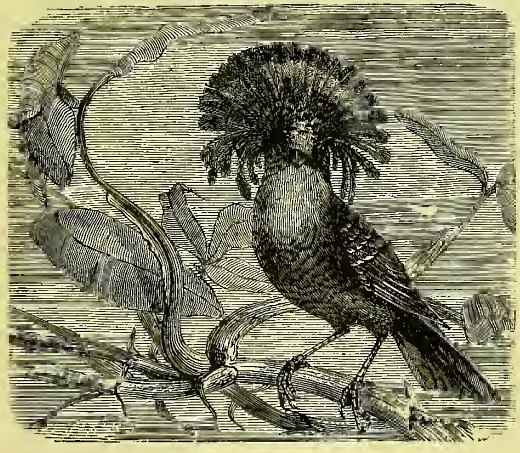
THE MEADOW PIPIT (*Anthus pratensis*).

The Tree Pipit (*Anthus arboreus*) derives its name from its habit of perching upon trees, wherein it presents a decided contrast to the meadow pipit, which chiefly frequents waste lands and marshes.

The Meadow Pipit (*Anthus pratensis*) is in many places called the moss-cheeper, in allusion to its peculiar plaintive note. In other parts it is known by the title of ling-bird, on account of its habit of haunting the waste moorlands. In Ireland the bird is called the wekeen, a name which evidently alludes to its note. It has been found in all the British Islands, and in many parts of Europe, extending as far northward as Sweden and Norway in the summer months, and having even been seen in Iceland. Specimens have been taken in Egypt and several parts of Africa, and also in the West of India. It has also been included in the list of Japanese birds, so that it possesses a range of locality which is seldom enjoyed by any single species.

IV.—THE FORMICAROID PERCHERS.

This section contains an assemblage of nearly a thousand species, almost all of which are to be met with in the New World; indeed, the tyrant shrikes, the manakins, the chatterers, ant-eaters, and American creepers are exclusively American families.



THE KING BIRD (*Tyrannus intrepidus*).

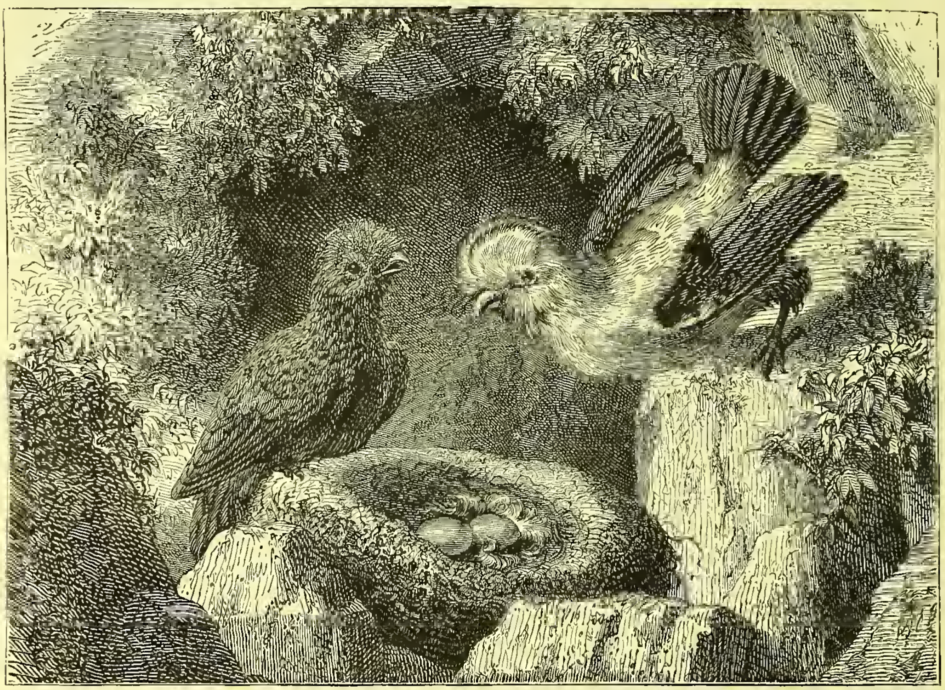
The family of the TYRANT SHRIKES, OR TYRANIDÆ, contains nearly one-third of all the species met with in this section.

The King Bird of North America (*Tyrannus intrepidus*) is one of the migratory species, arriving in the United States about the month of April, and remaining until the end of the autumn, when its young are fully fledged and able to shift for themselves. The name of the king bird has been given to this species, not only on account of the regal sway which it wields over most of the feathered race, but also on account of the flame-coloured crest which appears whenever the bird raises the feathers of the head.

The fine bird called the Fork-tailed Flycatcher (*Melvulus tyrannus*) also belongs to this family.

The MANAKINS, OR PIPRIDÆ, have been principally observed in Guiana. They prefer humid and cool woods to the hot and dry lands. They do not, however, frequent marshes or the borders of streams. They only perch on the middle branches of the trees in the woods, which they never quit to proceed into the open plains or to the neighbourhood of habitations. They assemble in the morning in small troops of from eight to ten in number of the same species, and frequently join company with other small birds. At such time their chirping is rather agreeable; but about nine o'clock they cease and retire alone until the following day into the most shady recesses of the forests. Their food consists of wild fruit, and they also eat insects.

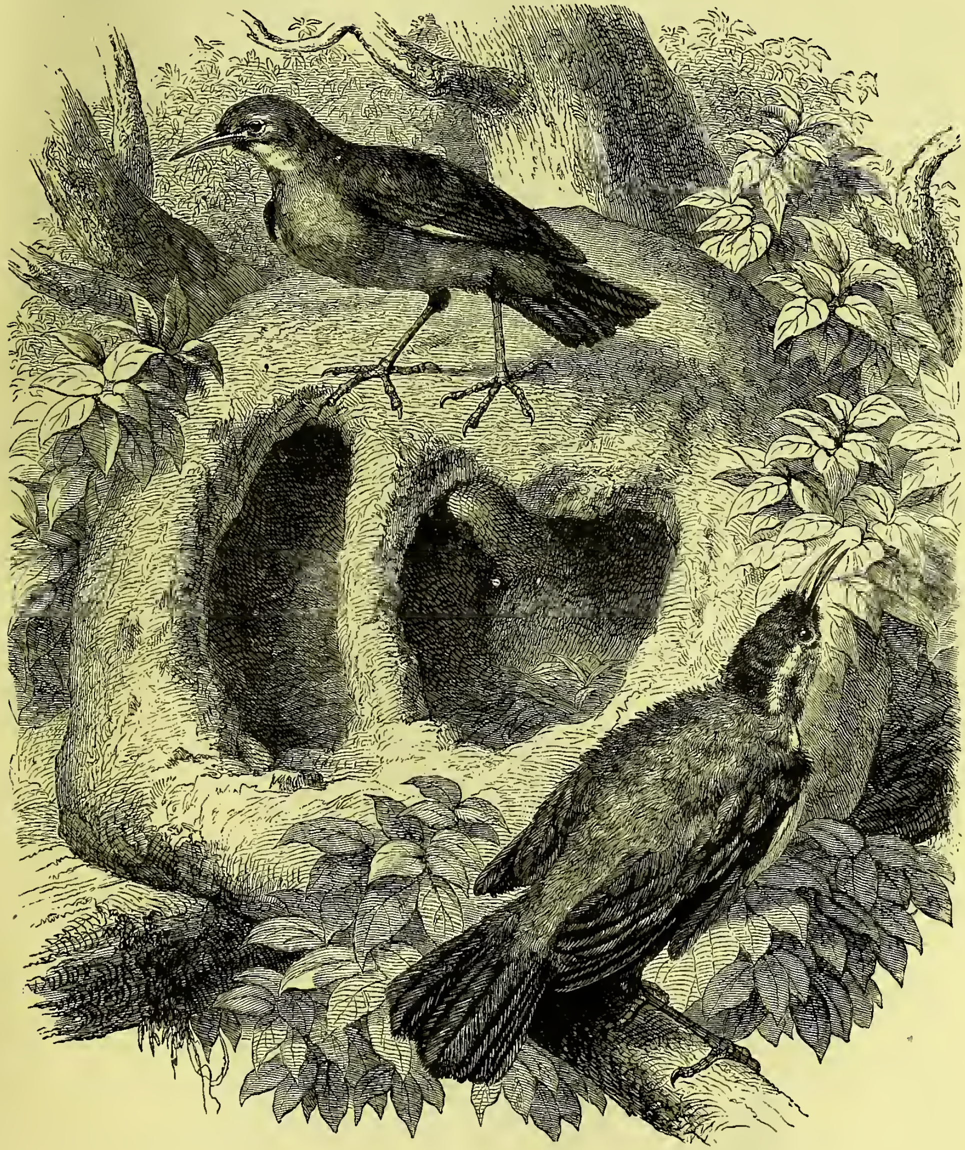
The CHATTERERS, OR COTINGIDÆ, number among them some of the most lovely of the birds of America. We can barely allude to the Cock of the Rock (*Rupicola crocea*), which is one of the most lovely birds of the present family. It is about the size of a small pigeon. The general colour of the plumage is rich saffron-yellow, with a tinge of orange. The head is adorned with a beautiful crest, flattened at the sides and rising like a fan. It is a native of South America, inhabiting the rocky and mountainous districts along the rivers of Surinam, Cayenne, and Guiana, and probably it may be found along the whole range of the river Amazon, with its tributary branches. According to Latham, it is nowhere so frequent as in the mountain Luca, near the river Aprouack, where it builds in the cavernous hollows and dark recesses. The nest is composed of a few dry sticks, and the eggs are two in number, of the size of those of a pigeon, and equally white. It is a shy and solitary bird, preferring silent and secluded glens and rocky ravines to all other spots, and there it seems to pass an undisturbed existence.



THE COCK OF THE ROCK (*Rupicola crocea*).

The Bell Bird of Brazil (*Chasmarhynchus nudicollis*), and the Umbrella Bird of the Amazons (*Cephalopterus ornatus*), belong to this family.

The BROAD BILLS, OR EURYLÆMIDÆ, and the PLANT CUTTERS, OR PHYTOTOMIDÆ, lead to the AMERICAN CREEPERS, OR DENDROCOLEPTIDÆ, brown birds, with more or less rigid tail feathers. Of these the Oven Bird (*Furnarius fugilinosus*) constructs its nest in the form of an oven. It is composed of earth, and though it is of considerable size, it is often completed in two days' labour, the male and female engaging equally in the task, each carrying a ball of mortar alternately about the size of a filbert. It is six inches and a half in diameter, and an inch thick. The opening, which is lateral, is twice as high as it is wide, and the interior is divided into two chambers by a partition, beginning at the entrance and carried circularly backwards.



OVEN BIRDS.

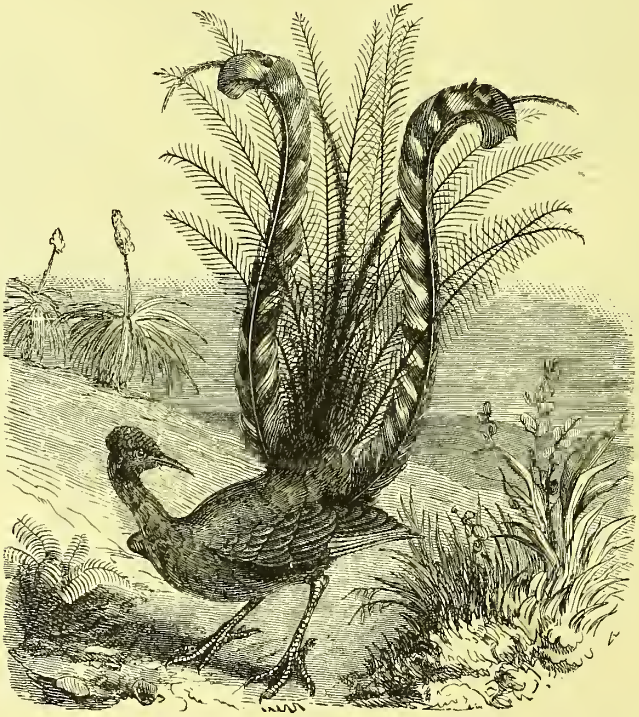
Then come the Synallaxine Birds, which are generally found upon trees, which they traverse with great rapidity in search of the various insects on which they feed, though they may often be seen running about upon the ground, peering anxiously into every little hole and cranny, and dragging slugs, snails, worms, and beetles from the recesses in which they are accustomed to conceal themselves during the hours of daylight; and the Creepers, with curved bills (*Dendrocolaptes*), which give the name to the order.

The Ant Thrushes, or Formicaridæ, are to be met in the warm districts of South America.

The Pittas, or Pittidæ, are an Old World group, abundant in the Malays. Among them are some beautiful coloured birds. Pitta bengalensis is, perhaps, the best known; and P. granatica is probably the most gorgeous.

We now come to two families, about the position of which there is great doubt. Of the Lyre Birds, or Menuridæ, but two species are known, which are found in Australia. The oldest known is the Lyre Bird (*Menura superba*). Its tail is composed of three different sorts of feathers, of which the upper side is a dark grey, with ferruginous spots. The first two lower feathers, which are a little curved in two directions, are beneath of a pearly colour, enriched with several crescent-shaped spaces of a rich rufous or black colour. The laminæ are unwebbed, turned round towards the extremity, and ornamented with a black bar the breadth of an inch, and fringed at the end. The shaft of the second, which is likewise long, is fringed with long hair-like filaments; and the third, which is also long and curved, is plumed on the inner side only, except at the extremity, where there are a few separated filaments of a dark grey colour. The tail of the female is simply brown, and composed of long uniform feathers, which are straight and graduated. The tail feathers are detached entire from the bird, and are sold in the shops in Sydney in pairs. The price was formerly low; but as the bird has, from being destroyed as it was not aforetime, become rare, the tails fetch 20s. to 30s. the pair. About the ranges of the Tumal country, where the gun has seldom been carried, they are more frequently seen.

The second family contains the Scrub Birds of Australia, or Atrechiidæ. Of these only two species are known, and Professor Newton considers that certain peculiarities of their structure separates them from all other perchers.

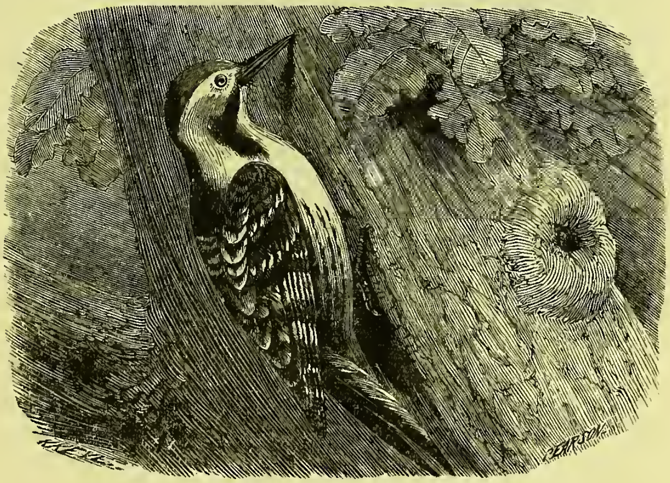


THE LYRE BIRD (*Menura superba*).

ORDER II.—PICARIÆ.

The birds placed in this order will doubtless, in process of time, require to be somewhat differently distributed. As constituted by Wallace, it contains a number of fissirostral birds, chiefly insect-feeders, and of such types as swifts, humming-birds, goatsuckers, trogons, leading to the jacamars, bee-eaters, kingfishers, and hornbills, added to which are the cuckoos, toucans, and the woodpeckers, these last being usually regarded as scansorial birds. In a work like this it is right to avoid controversy, and we content ourselves with following the classification we have adopted, even though we feel that it is open to some objections. The families placed in this order are, for the most part, well defined, and the total number of species known is little short of 1,700. Most of the families have representative species here and there all over the world; but one, and that not the least in importance —the humming-birds — is altogether confined to the warm regions of America. It is noteworthy that few of this order can sing; most of them are screechers, and some, like the cuckoos, have remarkable call notes.

The first family we will consider is that of the Woodpeckers, or Picidæ. These are widely distributed, but none of them are known to exist in the woods of Madagascar.


THE LESSER SPOTTED WOODPECKER (*Picus minor*).

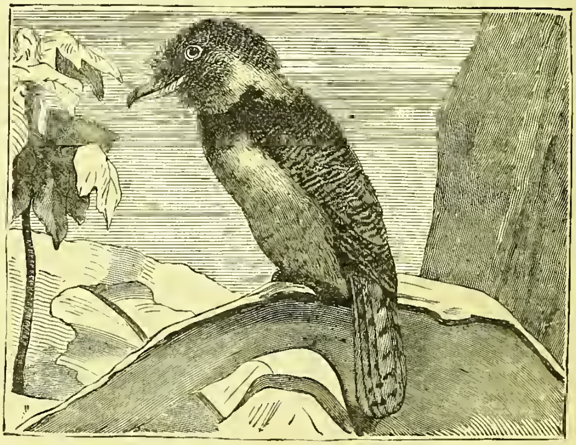
The Green Woodpecker (*Picus viridis*) is a native of Great Britain. It obtains its food both upon trees and on the ground; its flight is short, undulating, and rather laborious. "When seen moving upon a tree," says Mr. Yarrell, "the bird is mostly ascending in a direction more or less oblique, and it is believed to be incapable of descending unless this action is performed backwards. On flying to a tree to make a search the bird settles low down on the trunk or body of the tree, but a few feet above the ground, and generally below the lowest large branch, as if to have all its work above it, and proceeds from thence upwards, alternately tapping to induce any hidden insect to change its place, picking holes in a decayed branch that it may be able to reach any insects that are lodged within, or protruding its long extensible tongue to take up an insect on the surface; but the summit of the tree once obtained, the bird does not descend over the examined part, but flies off to another tree, or to another part of the same tree, to re-commence its search lower down nearer the ground." The Large Spotted Woodpecker (*P. major*), and the smaller one (*P. minor*), are also to be met with in England. A very large number of species are to be found in America, and the enthusiastic Audubon gives long details of their habits.

The Wrynecks, or Yungidæ, constitute a little family of small tree-creeping birds, of which one species, the Wryneck (*Yunx torquilla*), is known in Britain. The Greeks were acquainted with this bird. Aristotle has well described it: its long tongue, its power of protruding and retracting it, and the writhing snake-like motion which it can impart to its neck without moving its body. It was also the lynx of the Romans. Caterpillars and a variety of insects form the food of the wryneck, and it is a great devourer of ants and their eggs. Elderberries have also been mentioned as forming part of their diet.

Mr. Yarrell thus describes the construction of the tongue and its appendages in this species :—" By an elongation of the two posterior branches of the bones of the tongue, and the exercise of the muscles attached to them, this bird is able to extend the tongue a very considerable distance beyond the point of the beak. The end of the tongue is horny and hard; a large and long gland is situated at the under edge of the lower jaw on each side, which secretes a glutinous mucus, and transfers it to the inside of the mouth by a slender duct. With this glutinous mucus the end of the tongue is always covered, for the especial purpose of conveying food into the mouth by contact. So unerring is the aim by which the tongue is darted out, and so certain the effect of the adhesive moisture, that the bird never fails in attaining its object at every attempt. So rapid also is the action of the tongue in thus conveying food into the mouth, that the eye is unable distinctly to follow it." In captivity the wryneck is a favourite, and the bird soon becomes reconciled to the half-reclaimed state in which English and French boys are fond of keeping it —taking it out to the woods with a long string tied to its legs, and suffering it to ascend trees and forage for food generally within the length of its tether, and letting it climb at intervals about their dress.

THE WRYNECK (*Yunx torquilla.*)

The HONEY GUIDES, OR INDICATORIDÆ, are an interesting family, containing scarcely more than a dozen species. They catch and eat bees; occasionally they kill small birds. Some of the species are parasitical, like the cuckoo; they are nearly all African. Space forbids us copying out Sparrmann's account of their instincts, which would now seem authenticated. Mr. Barron says:—"Every one in Africa is too well acquainted with the honey guides to have any doubts as to the certainty either respecting this, or its information of its repositories of bees;" and Mr. Weedomann writes:—"So soon as this bird sees a man in the woods where a bee's nest is in the neighbourhood, he flies before him, crying, 'Sirt, sirt!'"

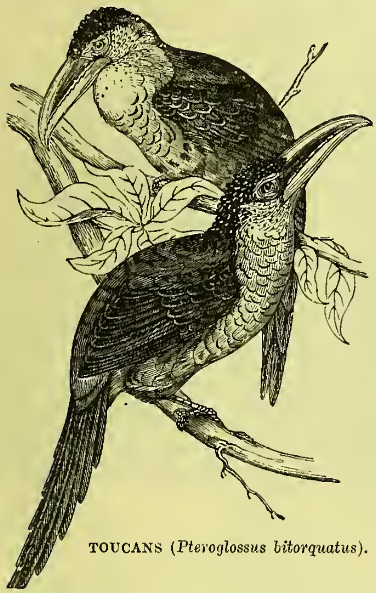

THE AFRICAN BARBET.

The BARBETS, OR MEGALŒMIDÆ, are small, stout, and not very neat-bodied birds, which feed on fruits. They are generally gaudy coloured, and are chiefly to be met with in Western Africa and tropical America.

The TOUCANS, OR RHAMPHASTIDÆ, differ from all other birds by their very remarkable tongues, which are long, slender, and feathered. They have also immense bills, and a very peculiarly-coloured plumage. They are fruit eaters, and hop actively about the tops of trees in the forests of the Brazils and Peru. We give a figure of the Collared Toucan (*Pteroglossus bitorquatus*).

The PLAINTAIN EATERS AND TURACOS, OR MUSOPHAGIDÆ, are handsome African birds, with the short neck and wings of the toucans, and legs like cuckoos.

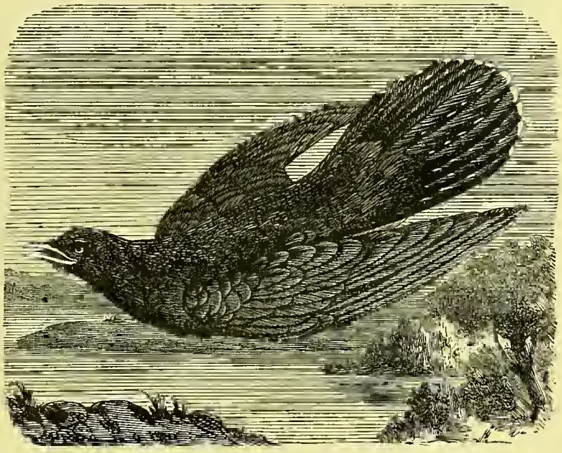
The Colies, or Colidæ, should also be noticed. The plumage of these birds is soft and silky, and the colour generally sombre. The colies are gregarious, live upon fruits, and are the scourges of gardens. They walk badly, but they climb almost continually on the branches of trees, where they hold on, assisting themselves with their bills, like the parrakeets. They build their nests, which are spacious and round, in little groups. The number of eggs in a nest is generally five or six.


TOUCANS (*Pteroglossus bitorquatus*).

The Cuckoos, or Cuculidæ, are a group of insectivorous birds, abounding in all the warmer regions of the world, and only appearing in the colder or more temperate zones as migratory birds. Many of them are parasitic, namely, not nest building for themselves, but depositing their eggs, when laid, in the nests of other birds. It is strange, too, how many of them bear a striking resemblance to other birds, as has often been noticed in the case of our common cuckoo, which is more or less hawk-like; while our familiar bird is dull-coloured, some of the Eastern cuckoos are adorned with vivid gold and violet lustre colours, and in some the bills and cheeks are bright-coloured.

The Cuckoo (*Cuculus canorus*) has the bill of moderate strength, the tarsus short, and the tail of ten feathers. It is remarkable for its singular and somewhat anomalous habit of depositing its eggs in the nests of other birds. The nest of the Hedge Sparrow (*Accentor modularis*) is that most usually chosen; in the south of England that of the yellow-hammer, the wagtail, and the meadow titlark being, however, likewise devoted to the purpose.

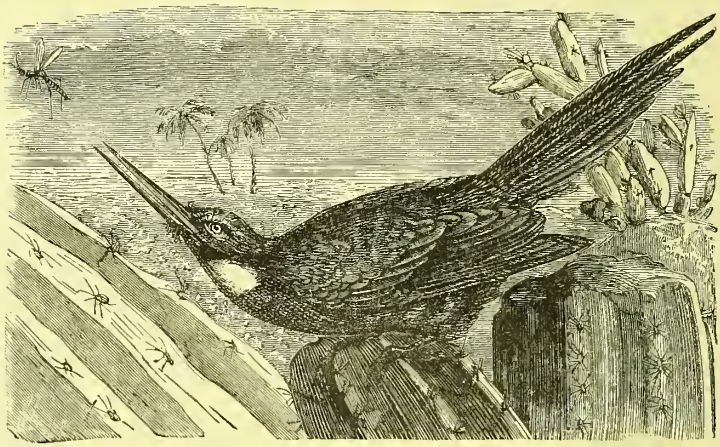
"In Northumberland," says Mr. Selby, "constant experience tells me that the nest of the last-mentioned bird is the one almost always chosen. Taking advantage of the absence of its dupe during the time of laying (which generally occupies four or five days), the cuckoo deposits its eggs among the rest, abandoning it from that moment to the care of the foster-parent. As the same period of incubation is common to both birds, the eggs are hatched nearly together, which no sooner takes place than the young cuckoo proceeds instinctively to eject its young companions and the remaining eggs from the nest. To effect this object, it contrives to work itself under its burden (the back at this early age being provided with a peculiar depression between the shoulders), and then shuffling backwards to the edge of the nest, by a jerk rids itself of the incumbrance; and this operation is repeated till, the whole being thrown over, it remains sole possessor. This particular tendency remains for about ten days, after which the hollow place between the shoulders is filled up; and when prevented from accomplishing its purpose till the expiration of that period, as if conscious of inability, it suffers its companions to remain unmolested." According to Aristotle and Pliny—and with them Linnæus appears to have concurred—the young cuckoo, when it had attained a sufficient size, would sometimes kill and eat its foster-mother. Hence, Shakespeare makes the Fool


THE CUCKOO (*Cuculus canorus*).

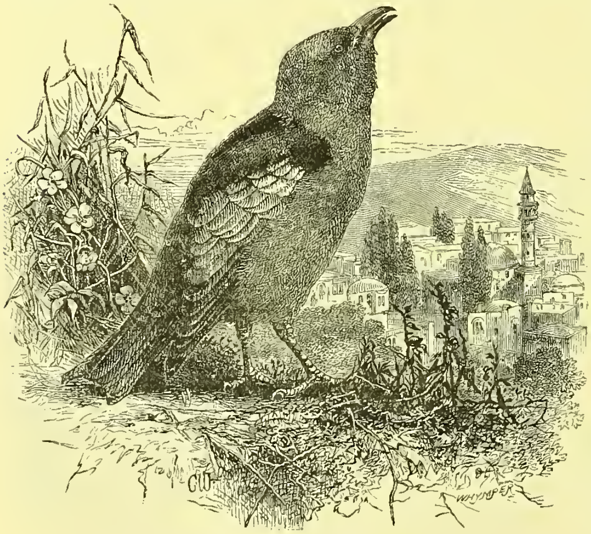
in the play of *Lear* say, alluding to the unnatural conduct of the unhappy king's daughters :—

> "The hedge sparrow fed the cuckoo so long,
> That it had its head bit off by its young."

That strange bird, the Leptosomus discolor, only met with in Madagascar, is constituted a separate family by Mr. Wallace, which comes after the cuckoo.


THE JACAMAR.

The PUFF BIRDS, OR BUCCONIDÆ. There is something very grotesque in the appearance of all the puff birds, and their habits, in a state of nature, are no less singular. They frequent open cultivated spots near habitations, always perching on the withered branches of a low tree, where they will sit nearly motionless for hours, unless, indeed, they descry some luckless insect passing near them, at which they immediately dart, returning again to the identical twig they had thus left, and which they will sometimes frequent for months. At such times, the disproportionate size of the head is rendered more conspicuous by the bird raising the feathers so as to appear not unlike a puff-ball : hence the general name they have received from the English residents in Brazil, of which vast country all the species, I believe, are natives. When frightened, this form is suddenly changed by all the feathers lying quite flat. They are very confiding, and will often take their situation within a few yards of one's window.


THE ROLLER (*Coracias garrula.*)

The JACAMARS, OR GALBULIDÆ, are somewhat like the bee-eaters of the Old World, and have the same geographical distribution as the previous family.

The ROLLERS, OR CORACIDÆ, are not met with in America, and are chiefly confined to the tropics of Africa; but one species, Coracias garrula, is found as far north as Sweden.

The BEE-EATERS, OR MEROPIDÆ, have nearly the same geographical distribution. The Common Bee-eater (*Merops apiaster*) is frequent in the South of Europe in the summer, Sicily, Sardinia, Italy, the south of France, and Germany possess it, and in the southern border of Russia it is numerous. It is found in Turkey and in the Grecian Islands, and in autumn migrates towards Egypt. It breeds in holes on the banks of the Don and the Volga, laying from five to seven white eggs in a nest composed of moss and other materials.

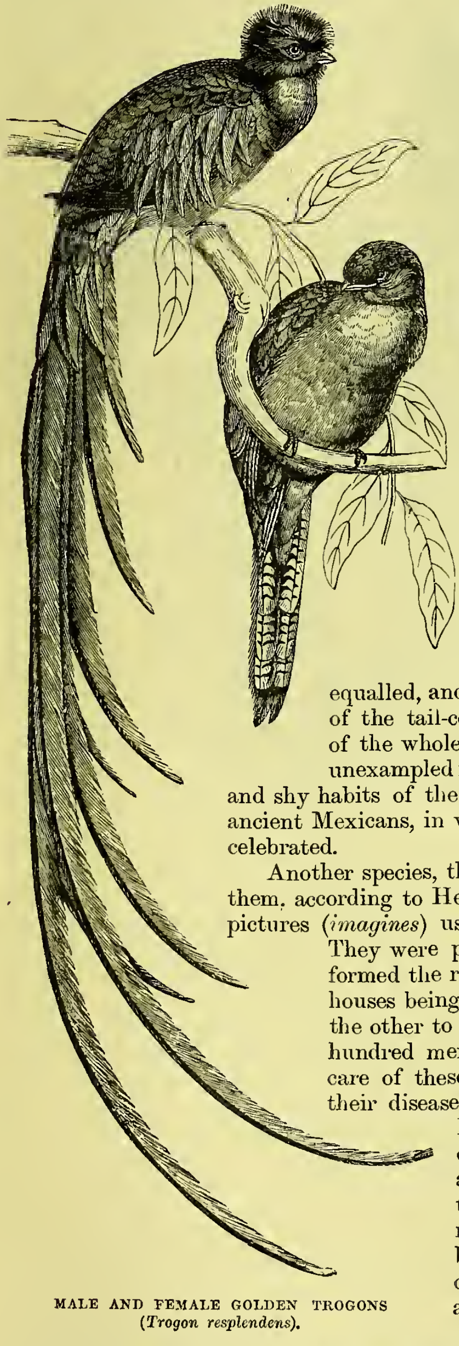
The LITTLE TODIES, OR TODIDÆ, are only found in a few of the West Indian Islands.

They are delicate, bright-coloured birds. The Green Tody (*Todus viridis*) is a very common bird. On the summit of Bluefields Mountain, about 3,000 feet from the level of the sea, and particularly where the deserted provision grounds are overgrown with an almost impenetrable thicket of jointwood, Mr. Gosse tells us it is especially abundant. Always conspicuous, from its bright grass-green coat and crimson velvet gorget, it is still a very tame bird, allowing a person to approach very near, and if disturbed, alighting on another twig a few yards distant. That naturalist says: "I have never seen the tody on the ground, but it hops about the twigs of the low trees, searching for minute insects, occasionally uttering a querulous sibilant note."

The Motmots, or Momotidæ, are limited to the warm regions of South America, which is also the chief abode of the next family.

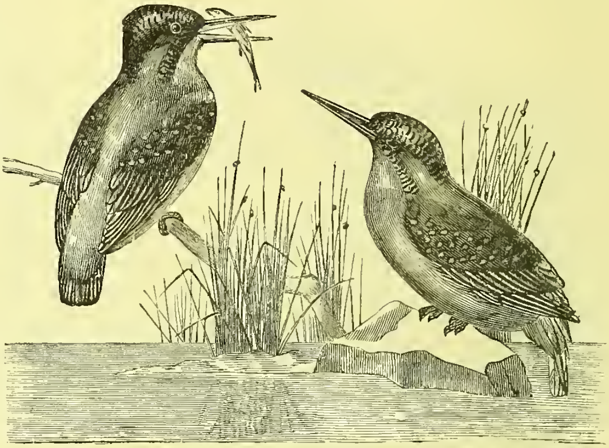
The Trogons, or Trogonidæ, are resplendent birds. which quite rival the birds of Paradise in the richness of their plumage, which glitters with the most brilliant metallic green. The Golden Trogon (*Trogon resplendens*) has the greater portion of its plumage apparently composed of burnished gold. The head ornamented by a brilliant crest, the wing-coverts falling in flakes of golden-green over the deep purplish-black of the primary and secondary quill-feathers, the rich carmine of the lower parts bestowing a warmth and depth of effect which no Venetian painter ever equalled, and the long, waving, and highly metallic feathers of the tail-coverts, extending about three times the length of the whole body, present a combination of beauty almost unexampled in the feathered tribes. The remarkable plumage and shy habits of the trogons did not escape the observation of the ancient Mexicans, in whose mythology one of the species at least was celebrated.

Another species, the Tzinitzan of the Mexicans, was employed by them, according to Hernandez, in the fabrications of the figures and pictures (*imagines*) used on festivals, in war, and in their temples. They were probably kept in one of the two houses which formed the royal menagerie of ancient Mexico, one of these houses being appointed to birds which did not live by prey, the other to birds of prey, quadrupeds, and reptiles. Three hundred men, according to Cortes, were employed to take care of these birds, besides their physicians, who watched their diseases and applied timely remedies. Of the three hundred attendants, some procured their food, others distributed it, others took care of the eggs at the time of incubation, whilst others at certain seasons picked their plumage; for the king not only delighted in the sight of so many species, but was very careful of their feathers for the sake of the famous feather images and pictures, as well as of the other works which were made of them.



MALE AND FEMALE GOLDEN TROGONS
(*Trogon resplendens*).

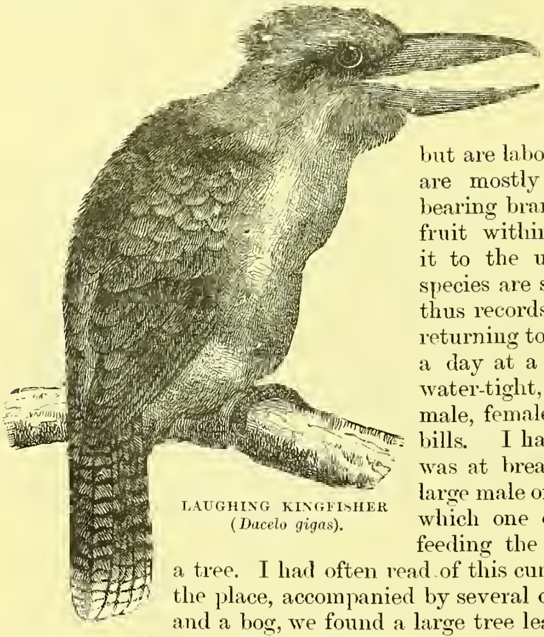
The Kingfishers, or Alcedinidæ, form nearly as attractive a family, and one that is more universally scattered. They are found almost everywhere over the globe; but very few species, and these belonging to a single genus (*Ceryle*), are found in America, though it is the land of rivers, and these abounding in fish.



KINGFISHERS (*Alcedo ispida*).

The Common Kingfisher (*Alcedo ispida*) is a bird of which many marvellous stories are told. It inhabits holes or burrows on the banks of streams, spending much time near the water, or perched on the neighbouring bushes. It partly lives by fishing, but it catches also dragon-flies and other water insects, swallowing all its prey entire, and casting up, like owls, whatever is indigestible. Perched on some slender twig overhanging the water, it might be mistaken for the gay flower of some water-plant ; and so sure is it of instant escape, if desirable, that it will allow the observer a tolerably near approach, and if he does not offer violence or make any noise—for the kingfisher especially loves silence—he may watch its movements on the surface of the brook. But startle it, and few sights in some quiet spot are more pleasing than the first glance of this bird as it darts in its rainbow hues along some reach of a clear and placid stream, gliding between soft banks richly fringed with reeds and bushes. Keen indeed must be the eye that follows it in its course, for rapidly will it fly, halt, and hover for a time, and then, darting downwards, seize a little fish, a leech, or even a worm, and instantly bring it to land.

The Laughing Kingfisher (*Dacelo gigas*), is one of the largest species. It comes from Australia, and is said to eat reptiles as well as fish. The exquisitely beautiful Long-tailed Kingfishers, belonging to the genus Tanyseptera, come chiefly from the Moluccas and New Guinea. One species extends to North Australia.



LAUGHING KINGFISHER (*Dacelo gigas*).

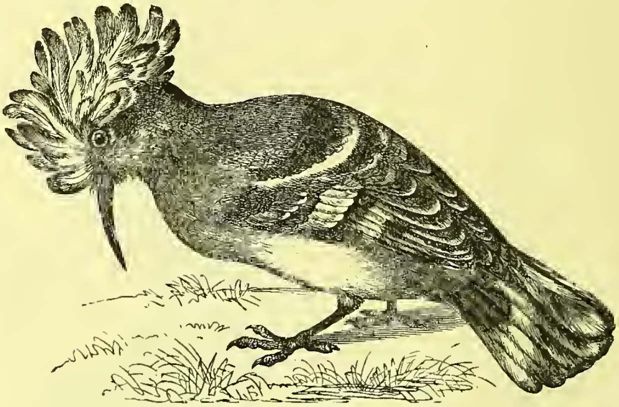
The HORNBILLS, OR BUCEROTIDÆ, are large birds, with short legs, united toes, with a broad flat sole, like the kingfisher. They have immense wings, but are laboured in flight, which is not rapid. They are mostly frugivorous. Alighting on a fruit-bearing branch, they soon pick it bare of all the fruit within reach, but they never venture out for it to the uttermost twigs. Some of the African species are said also to eat reptiles. Mr. Wallace thus records their strange nesting habits :—“ While returning to Palembang by water, and while staying a day at a village while a boat was being made water-tight, I had the good fortune to obtain a male, female, and young of one of the large hornbills. I had sent my hunters to shoot, and while I was at breakfast they returned, bringing me a fine large male of the Double Hornbill (*Buceros bicornis*), which one of them assured me he had shot while feeding the female, which was shut up in a hole in a tree. I had often read of this curious habit, and immediately returned to the place, accompanied by several of the natives. After crossing a stream, and a bog, we found a large tree leaning over some water ; and on its lower side, at a height of about twenty feet, appeared a small hole, and what looked like a quantity of mud, which I was assured had been used in stopping up the large hole. After a while we heard the harsh cry of a bird inside, and could see the white extremity of its beak put out. I offered a rupee to any one who would go up and get out the bird, with the egg or young one; but they all declared it was too difficult, and they were afraid to try. I therefore very reluctantly came away. In about an hour, much to my surprise, a tremendous loud hoarse screaming was heard, and the bird was brought me, together with a young one which had been found in the hole. This was a most curious object, as large as a pigeon, but without a particle of plumage on any part of it. It was exceedingly plump and soft, and with a semi-transparent skin, so that it looked more like a bag of jelly, with head and feet stuck on, than like a real bird. The extraordinary habit of the male, in plastering up the female with her egg, and feeding her during the whole time of incubation and till the young one is fledged, is common to several of the large hornbills, and is one of those strange facts in natural history which are 'stranger than fiction.'"

THE HORNBILL (*Buceros rhinoceros*).

The Hoopoes, or Upupidæ, form a small family, not found in America. Their nearest affinities seem to be with the hornbills. The Common Hoopoe (*Upupa epops*) is the epops of the Greeks, and the upupa and epops of the Romans. Ovid describes it well as he thus pictures the metamorphosis of Tereus:—

"Tereus, through grief and haste to be reveng'd,
Shares the like fate, and to a bird is changed.
Fixed on his head the crested plumes appear,
Long is his beak, and sharpen'd as a spear."

The arched crest upon the head is formed by two parallel rows of long feathers, of a ruddy buff colour, terminated with black. The female is less than the male, her crest shorter, and the tints of her plumage less vivid. It is a summer bird of passage on the Continent, where it travels northwards as far as Sweden. It never breeds in Britain, though it sometimes accidentally occurs there. This bird is called bubbola by the Italians, most likely from its peculiar cry. It keeps itself concealed among the trees; but is constantly heard repeating the syllable "bu, bu, bu, bu, bu," with such a strong, sonorous voice, that it may be heard at a great distance. Although the hoopoe lives and builds in woods, it may be often seen, in search of insect food, in fields and pastures. The nest is generally placed either in the natural hollow of a tree, or in the deserted excavation of a woodpecker. It is composed outwardly of feathers, and is lined with the hair of cows and horses. The eggs are greyish-white, finely spotted with brown.

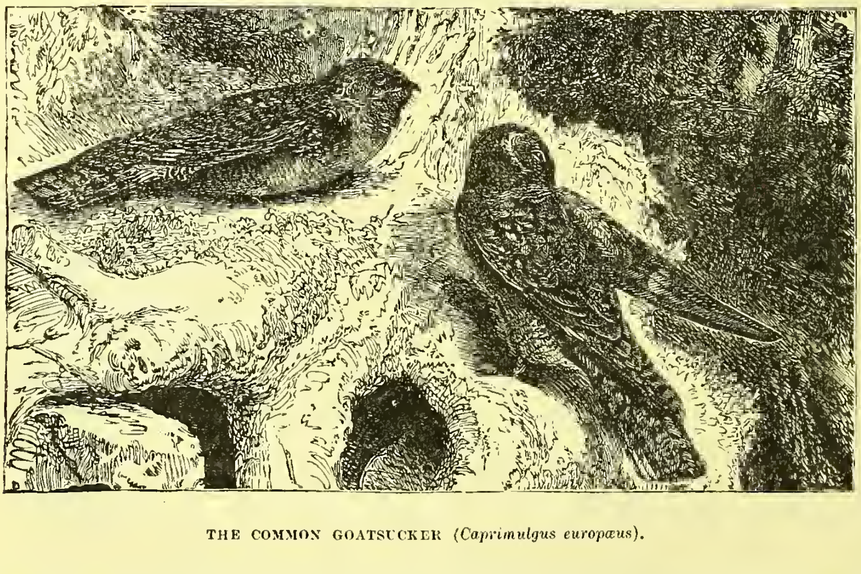


THE HOOPOE (*Upupa epops*).

The IRRISORIDÆ, according to Wallace, are more nearly allied to the hoopoes than to the birds of Paradise. They are strictly limited to Africa.

The FROG MOUTHS, OR PODARGIDÆ, are large night-feeding birds, catching insects chiefly on the ground or in trees, and not seizing it on the wing like the TRUE GOATSUCKERS, OR CAPRIMULGIDÆ. The plumage of these latter birds is wonderfully soft, and their flight is swift, though silent. Their cries are among the strangest belonging to birds. They are very widely distributed. Sometimes they are called night-jars. The Common Goatsucker (*Caprimulgus europæus*) has very large eyes; its plumage is full, soft, and downy; its gape enormous; its wings long; its tarsi very short and generally feathered; three of its toes are before, and there is one behind, but this can be brought forward; and the nail of the middle, in most species, is pectinated on its internal edge. The female has the plumage of the male generally, but she wants the white spots he has on the quills and tail-feathers.

Aristotle speaks of it "as laying to the number of two or three eggs at most, and being of a slothful nature. Flying upon the goats, it sucks them, whence it has its name. They say that when it has sucked the teat it becomes dry, and that the goat becomes blind. It is not sharp-sighted by day; but it sees by night." Ælian also refers to the absurd story of the goat-sucking habits of this bird, which may, probably, be referred to a still earlier date.



THE COMMON GOATSUCKER (*Caprimulgus europæus*).

Gilbert White alludes to the prejudice of his own time that this bird was very injurious to weanling calves, by inflicting, as it strikes at them, the fatal distemper known to cow-leeches by the name of "puckeridge." "But the truth of the matter is," he says, "the malady is occasioned by the Œstrus bovis, a dipterous insect, which lays its eggs along the chines of kine, where the maggots, when hatched, eat their way through the hide of the beast into the flesh, and grow to a very large size."

These birds live in solitary retreats, whence they emerge on noiseless wing, chasing the insects which, like themselves, sport in the murky twilight. The blended hues of grey and brown which decorate their plumage well accord with the shades of evening, and thus favour their concealment. So wide is their gape that they cannot miss their prey; and the mandibles are provided with a row of stiff bristles.

The Whip-poor-will (*Caprimulgus vociferus*) is an American bird with a most extraordinary power of voice. The notes of this solitary bird may be first heard issuing from some retired part of the woods, the glen, or the mountain; in a few evenings, perhaps, they are heard from the adjoining coppice, the garden-fence, the road before the door, and even from the roof of the dwelling-house, long after the family have retired to rest. Some of the superstitious consider these visits to forebode no good to the household; but, as they continue to take place without the slightest injury arising, this ignorant dread is on the decline.

The first and last syllables of the words "whip-poor-will" are uttered with great emphasis, and the whole in about a second to each repetition; but when two or more males meet, their "whip-poor-will" altercations become more rapid and incessant, as if each were striving to overpower or silence the other. When near, an introductory cluck may be heard between the notes. They generally fly low, not more than a few feet from the surface, skimming about the house and before the door, alighting on the wood-pile, or settling on the roof. Towards midnight they generally become silent, unless in clear moonlight, when they may be heard with little intermission till morning. If there be a creek near, with precipitous, bushy banks, they are sure to be found in such situations.

THE WHIP-POOR-WILL (*Caprimulgus vociferus*).

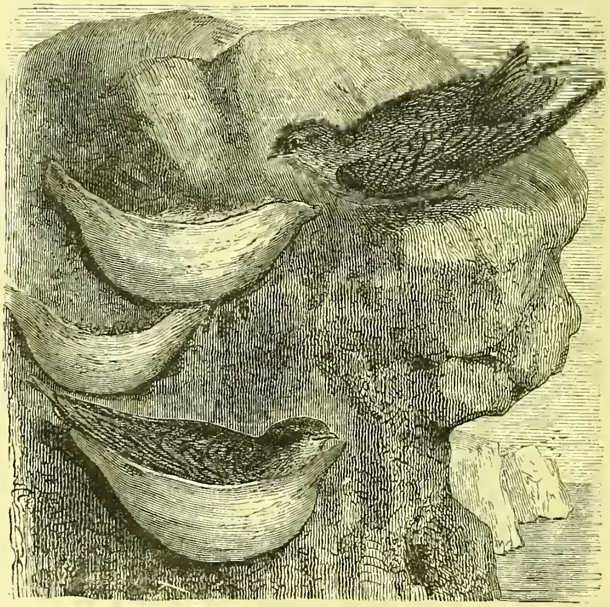
The Guacharo, or Oil Bird (*Steatornis caripenses*), seems to form a family in itself, for it is a fruit-eater. It was discovered in America by Humboldt and Bonpland, on their excursions to the mountains of Caripe, in Cumana. Here they entered an immense cavern, where a curious sight and still more strange sounds awaited them. We are assured that it is, indeed, very difficult to form an adequate conception of the frightful noise which smote upon their ears from the thousands of birds who dwelt in this dark abode, and the sounds they uttered were re-echoed in the caverns around. The Indians who guided the visitors fixed their torches at the end of long poles, and thus showed the nests of the birds, which were fifteen or sixteen feet over head. The noise of the terrified inmates increased as the intruders advanced; and when, at length, it ceased, for some minutes around the travellers the same doleful cries might be heard sounding through the other caverns, which extended in various directions. The Indians enter these caves once a year, armed with poles, with which they destroy the greater part of the nests. They also kill many thousands of the birds; and the old ones, as they defend their broods, hover around the heads of the assailants, and utter the most melancholy cries. These birds are collected for the sake of their oil, which is said to be like olive-oil, and to keep for a long time without becoming rancid. It has also been found in the Island of Guadaloupe and Trinidad.

The TRUE SWIFTS, OR CYPSELIDÆ, like the Goatsuckers, are insect-feeders, and catch their prey on the wing. They are to be met with almost everywhere, but are not found in New Zealand. The Common Swift (*Cypselus apus*) usually comes to this country from Africa early in May, and leaves us generally by the middle of August. Its weight appears disproportionately small to its extent of wing, the former being scarcely one ounce, the latter eighteen inches; the length is nearly eight inches. The feet are so small that the action of walking and rising from the ground is extremely difficult, but it is furnished with ample means for an easy and continual flight, which is rapid, and is often attended with a shrill scream. It breeds under the eaves of houses, in steeples, and other lofty buildings; makes its nest of grasses and feathers, and lays only two eggs, of a white colour. It is entirely of a glossy, dark, sooty colour, only the chin is marked with a white spot.

THE SWIFT (*Cypselus apus*).

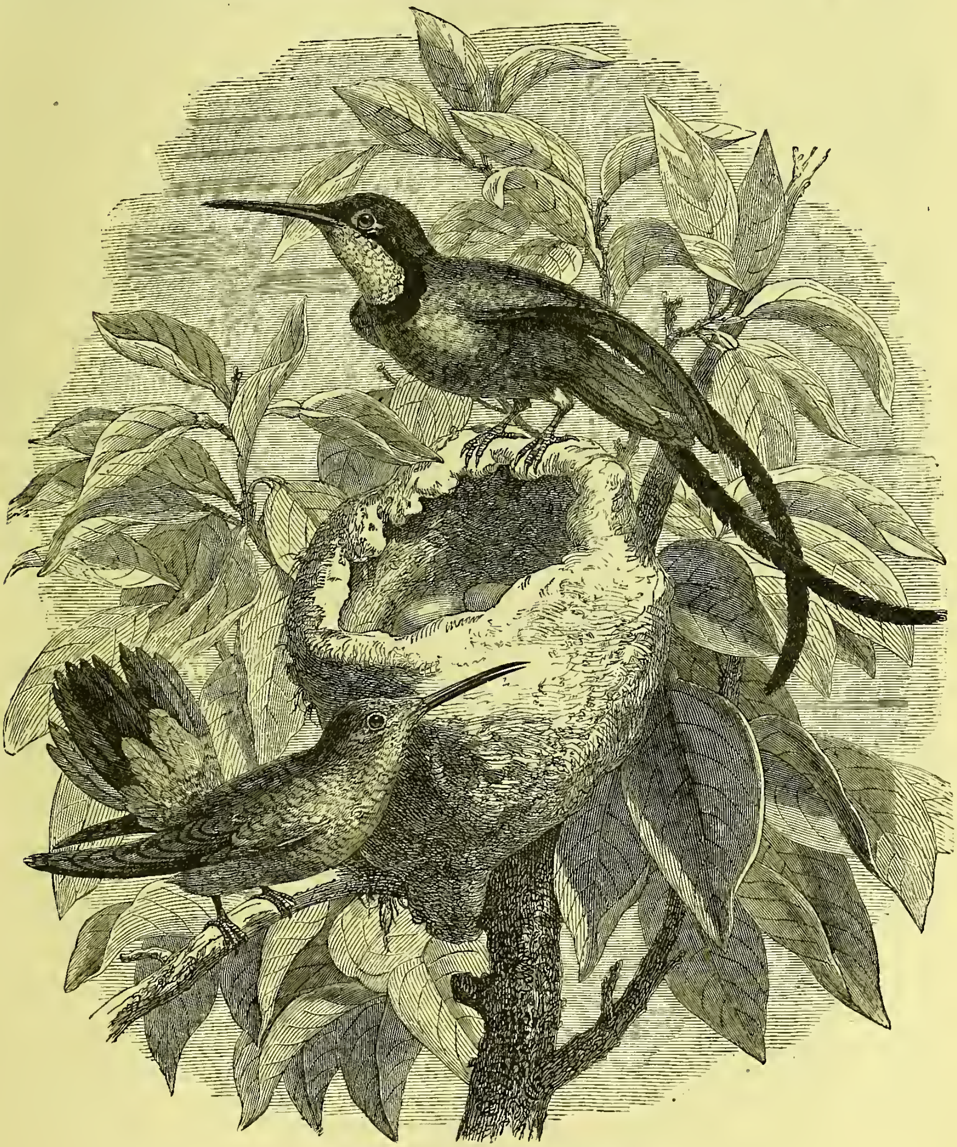
The swifts belonging to the genus Dendrochelidon attach their nests to trees; but the so-called Esculent Swift (*Callocalia esculenta*) attaches its nest to the highest and most inaccessible rocks, in deep, damp caves. Craufurd states that none but those accustomed to the dangers it offers can pursue the occupation of collecting these nests; for they are often approachable by a perpendicular descent of many hundred feet, by ladders of bamboo and ratan, over a sea rolling violently against the rocks. When the mouth of the cave is attained, the perilous task of taking the nests must be performed by torchlight, by penetrating into the recesses of the rock, where the slightest slip would instantly be fatal to the adventurers, who can see nothing below them but the turbulent surf making its way into the chasms of the rocks. The high price given for these delicacies is, however, a sufficient inducement for the gatherers to follow this dreadful trade.

The nests, formed of mucilaginous sea-weeds, resemble ill-concocted fibrous isinglass, and are of a white colour, inclining to red; their thickness little more than that of a silver spoon, and the weight from a quarter to half an ounce. When dry they are brittle and wrinkled, the size being nearly that of the half of a goose's egg. The qualities of the nest vary, according to the situation and extent of the caves in which they are found, and the time at which they are taken; if procured before the eggs have been laid, the nests are of the best kind; if they contain eggs only, they are still valuable; but if the young are in the nest, or have just left it, they are nearly worthless, being intermixed with feathers and dirt.



THE ESCULENT SWIFT (*Callocalia esculenta*).

After they are procured, they are separated from feathers and dirt, carefully dried and packed, and are then fit for the market. The best sort in China are sent to Pekin, for the use of the Emperor. They have the reputation of being nutritious and gently stimulating. The extravagant prices given for these nests by the Chinese make them a most expensive article of diet. Meyen states that the Japanese had long ago discovered that these costly birds' nests were nothing more than softened seaweed, and that they now prepare the substance itself in an artist-like manner.



THE TOPAZ HUMMING BIRD (*Topaza pyra*).

Although in their habits the swifts resemble the swallows, yet they widely differ from them in the structure of their feet and of their trachea; they have no power of song, and they are evidently related to the next family.

A large volume might easily be written about the HUMMING BIRDS, OR TROCHILIDÆ. These lovely gems among birds are confined to the American Continent, and though nearly tropical in their distribution, some few species extend upwards on the slopes of the Great Andes to the very regions of eternal snow. There is now no doubt that they are insect-eaters, although they may also use largely the nectar of flowers. There are nearly four hundred species of these exquisite creatures known, a vast number of which will be found figured, of the size and in the colours of life, in Mr. Gould's wonderful work on the humming birds.

"Where," says Audubon, "is the person who, on seeing one of these lovely little creatures moving on humming winglets through the air, suspended as if by magic in it, flitting from one flower to another with motions as graceful as they are light and airy, pursuing its course over our extensive Continent, and yielding new delights wherever it is seen: where is the person, I ask of you, kind reader, who, on observing this glittering fragment of the rainbow, would not pause and admire?"

Amid such a number of species, it is most difficult to choose which to notice. We select the Vervain Humming Bird (*Mellisuga humilis*), which is one of the smallest. It is found in Jamaica, and Mr. Gosse thus delightfully writes of it:—"I have sometimes watched with much delight the evolutions of this little species at the moringa-tree already spoken of. When only one is present, he pursues the round of the blossoms soberly enough, sucking as he goes, and now and anon sitting quietly on a twig. But if two are about the tree, one will fly off, and, suspending himself in the air a few yards distant, the other presently shoots off to him, and then, without touching each other, they mount upward, with a strong rushing of wings, perhaps for five hundred feet. Then they separate, and each shoots diagonally towards the ground, like a ball from a rifle, and wheeling round, comes up to the blossoms again, and sucks and sucks as if it had not moved away at all. Frequently one alone will mount in this manner, or dart on invisible wing diagonally upward, looking exactly like a humble-bee. Indeed, the figure of the smaller humming birds on the wing, their rapidity, their arrowy course, and their whole manner of flight, are entirely those of an insect; and one who has watched the flight of a large beetle or bee, will have a very good idea of the form of one of these tropic gems, painted against the sky. I have observed all our three species at one time, engaged in sucking the blossoms of the moringa at Content; and have noticed that whereas polytmus and mango expand and depress the tail when hovering before flowers, humilis, on the contrary, for the most part, erect the tail, but not invariably.

"The present is the only humming bird that I am acquainted with that has a real song. Soon after sunrise in the spring months it is fond of sitting on the topmost twig of some mango or orange-tree, where it warbles, in a very weak but a very sweet tone, a continuous melody for ten minute sat a time. It has little variety. The others have only a pertinacious chirping.

"The season of nidification seems to be as protracted in this as in the former species; nor does the structure itself differ, except in being about half the size. The small bushes of Lantana, so common by roadsides, and always covered with orange and yellow blossom, are favourite situations for the domestic economy of this minim bird. The smooth twigs of the bamboo also are not unfrequently chosen. It is not an uncommon thing in Jamaica for a road up a mountain to be cut in zig-zag terraces to diminish the steepness, and to prevent the lower side of such a road from crumbling away stems of green bamboo are cut and laid in a shallow trench along the edge. Shoots spring from every joint, and presently a close row of living palisades are growing along the margin of the road, whose roots, as they spread, effectually bind together the mountain side, and make the terrace perpetual; while, as they increase in height and thickness, they throw their gracefully-waving tufts over the way, like gigantic ostrich plumes, affording most refreshing shadow from the heat. Such a bamboo walk, as it is called, winds up the steep side of Grand Vale Mountain, in St. Elizabeth's, and here the nests of the Vervain humming bird are frequently met with.

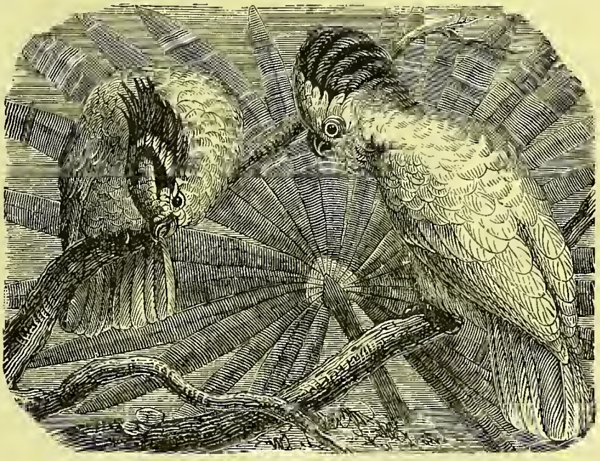
"One day in June, being up this road, I found two nests attached to twigs of bamboo, and one just commenced. Two parallel twigs were connected together by spiders' webs, profusely but irregularly stretched across, and these held a layer of silk cotton, which just filled up the space (about an inch square) between them; this was the base. The others were complete cups of silk cotton, exceedingly compact and neat, ornamented outside with bits of grey lichen stuck about. Usually the nest is placed on the joint of a bamboo branch, and the diverging twigs are embraced by the base. The nest is about the size of half a walnut-shell, if divided, not lengthwise, but transversely."

ORDER III.—THE PARROTS (*Psittaci*).

By some this group of birds is thought to surpass all others in intelligence, and it rivals most of the orders in beauty. The birds belonging to it have a large strong bill; the upper mandible is generally very much larger than the lower, and is much curved, forming an acute point, which overlaps the lower mandible. The base of the upper mandible is clothed with a cere, in which the nostrils are pierced. The tongue is for the most part soft and fleshy, but in the Lories it is furnished with a tuft of feathers. As a general rule, the wings and tail are long; the legs are short and stout, and the feet are formed for grasping. They live, for the most part, among trees, but some live on the ground. They feed principally on fruits. Nearly four hundred species are known, and nearly all of them are tropical or sub-tropical. Some few are to be found in the temperate regions, and Australia possesses a very large number of species.

The Cockatoos, or Cacatuidæ, form a family distinguished by the possession of a crest. They are only to be met with in Australia, and some few of the Philippine and Malay Islands. They feed upon seeds and soft stony fruits, which latter their powerful bill enables them to break with ease. Like others of their congeners, they make their nests in decayed trees, and are easily tamed when taken at an early age. They become familiar and even attached, but their imitative powers seldom go beyond a few words, added to their own cry of "cockatoo."

The Small Sulphur-crested Cockatoo (*Cacatua sulphurea*) is often seen in confinement; for though rarely able to articulate more than a few words, its handsome appearance, docile disposition, and amusing habits, render it a great favourite with those who delight in feathered pets. It is kind and affectionate to those it is accustomed to see, and who feed and take care of it, but suspicious of strangers, whose caresses it rarely admits of with impunity. When alarmed or irritated, it erects the crest to the fullest extent, making a peculiar noise; at other times it is kept depressed, and hanging over the nape of the neck.



THE SULPHUR-CRESTED COCKATOO (*Cacatua sulphurea*).

The general plumage of the body is white, slightly tinted upon the breast, sides, and inner wing-coverts with pale sulphur-yellow. The crest, in form like that of the other species, and the ear spot, are fine sulphur-yellow. The legs and toes are grey; the irides red. It is a native of the Moluccas and other Indian islands.

Professor T. R. Jones describes himself as, some years ago, strolling into the parrot-house in the Gardens of the Zoological Society, as he thought, very quietly and inoffensively, and certainly without the remotest idea of giving umbrage to any of its pretty feathered occupants, when, to his great surprise, his entrance seemed to be the signal for a wild and general disturbance.

"The sound of the tocsin," he says, "could not have roused an insurrection more uproarious than that produced by the appearance of our (pardon us, gentle reader, if we flatter ourselves) by no means repulsive physiognomy. Dire was the screaming, fierce the gesticulation, of every scansorial biped among them. Parrots, macaws, and cockatoos seemed equally indignant at our intrusion; and such a clamour as they raised, such a whirlwind of discordant sounds, would certainly have done credit to Babel. Overwhelmed with noise, deafened with the terrible cacophony, we beat a retreat, and right gladly escaped into the quiet glades of the gardens.

"On our return, after an hour or so, finding that all was tranquil within, we again entered the parrot-house, and again were greeted with a concert, beating marrow-bones and cleavers, and all rough music imaginable.

"Wondering what could be the cause of a reception so uncourteous where before we had always been a welcome visitor, we approached an old favourite cockatoo, and reproachfully holding up a little walking-cane before her face, began to expostulate with her on such behaviour. We could scarcely have imagined the picture of rage and terror that the bird presented. With crest erected to the uttermost, staring eyes, and limbs trembling all over, she retreated to the extreme limits of her chain, and struck with her wings at my cane, as if fighting for very life; and so indeed she was, or thought she was, for, on my attention being thus directed to my little cane, I appreciated at once the cause of her fury: the head of the walking-stick was carved in imitation of that of a serpent, with brilliant eyes and a most grim and threatening aspect. The supposed appearance of so terrible a foe amongst their peaceful party had, by an instinct true and natural, roused them to self-defence, affording at once a proof of the carver's skill who had so ornamented my ratan, and an illustration of instinctive horror of a very interesting character."

ROSE BILL PARRAKEETS.

The LARGE-TAILED PARROTS, OR PLATYCERCIDÆ, are peculiarly Australian. Some of the species are ground-feeders, of which we may instance the Ground Parrot of New Holland (*Pegoporinus formosus*). It is a beautiful little bird, which measures about a foot in length, including the tail, which is regularly banded with green and black; the general plumage is also variegated with the same colours, each feather having a blackish-brown band. This bird lives entirely upon the ground; and Mr. Gould states that he never saw it perching, nor was he ever able to drive it to take shelter in a tree. He gives the following account of its habits:—"It usually frequents either sandy sterile districts, covered with tufts of rank grass and herbage, or low swampy flats, abounding with rushes and the other kinds of vegetation peculiar to such situations. It is generally observed either singly or in pairs; but from its very recluse habits and great powers of running, it is seldom or ever seen until it is flushed, and then only for a short time, as it soon pitches again, and runs off to a place of seclusion, often under the covert of the grass-tree (Xanthorrhœa), which abounds in the district it frequents." Its eggs are laid on the ground.

The beautiful little Grass Parrakeets, also inhabitants of Australia, are to a considerable extent terrestrial in their habits, but less so than the bird just referred to. One of the most charming of these, and, indeed, of all the parrots, is the diminutive Warbling Grass Parrakeet (*Melopsittacus undulatus*), which is found abundantly over the vast central plains of Australia, but is scarcely ever seen in the districts between the mountain chains of that singular country and coast. They feed in large flocks upon the seeds of the grasses which abound in the plains, but rest during the heat of the day upon the branches of the gum-trees (*Eucalypti*), in the hollows of which they also lay their eggs and bring up their young. Upon these trees they also collect in crowds before starting in search of water. In captivity, these diminutive creatures are amongst the most pleasing of the parrots, for they are not only elegant in their forms and lively in their movements, but, instead of the horrible screeching noise, which renders so many of their larger and more brilliant brethren exceedingly disagreeable neighbours, they have a soft warbling note, which is very pleasant. Several other species of grass parrakeets, belonging to the genus Euphema, are also found in Australia, and they are all exceedingly elegant little creatures. Professor Garrod thinks these ground-feeders are nearly allied to the Owl Parrot of New Zealand (*Strigops*).

The PARRAKEETS AND LORIES, OR PALÆORNIDÆ, are found chiefly in the Indian Ocean

Islands, extending to Australia in one direction, and to the Mauritius and the Seychelles in another.

The Alexandrine Parrakeet (*Palæornis alexandri*) is a well-known species. It has been supposed that it was brought to Europe from Ceylon, where a closely-allied species is to be met with. In the reign of Nero, the Romans introduced other species from different quarters of Africa. They were highly prized by that luxurious people, who lodged them in superb cages of silver, ivory, and tortoiseshell; and the price of a parrot in those days frequently exceeded that of a slave. Nor did Ovid think it beneath him to write a lengthened elegy on the death of Corinna's favourite, a bird which, in the love it bore its mistress, seems to have emulated that of the dying Greek for his country:—

> "Clamavit moriens lingua Corinna vale"
> "Its dying tongue cried, 'Corinna, farewell!'"

Mr. Layard tells us that he has seen such vast flights of parrakeets coming to roost in the cocoa-nut-trees which overhang a bazaar, that their noise drowned the babel of tongues bargaining for the evening's provisions. "Hearing of the swarms which resorted to this spot, I posted myself on a bridge some half mile distant, and attempted to count the flocks, which came from a single direction to the eastward. About four o'clock in the afternoon, straggling parties began to wend towards home, and in the course of half an hour the current fairly set in. But I soon found that I had no longer distinct flocks to count: it became one living, screaming stream. Some flew high in the air till right above their homes, and dived abruptly downward, with many evolutions, till on a level with the trees; others kept along the ground, and dashed close by my face with the rapidity of thought, their brilliant plumage shining with an exquisite lustre in the sunlight. I waited on the spot till the evening closed, when I could hear, though no longer distinguish, the birds fighting for their perches; and on firing a shot they rose with a noise like the rushing of a mighty wind, but soon settled again, and such a din commenced as I shall never forget. The shrill screams of the birds, the fluttering of their innumerable wings, and the rustling of the leaves of the palm-trees, was almost deafening, and I was glad at last to escape to the Government Rest House."

THE MACAW.

The Brush-tongued Parrakeets, or Trichoglossidæ, are almost exclusively Australian, but some are found in New Guinea and the Solomons.

The Macaws, or Conuridæ, are wholly confined to America, being found flying about during snowstorms at the Straits of Magellan and up to Lake Michigan.

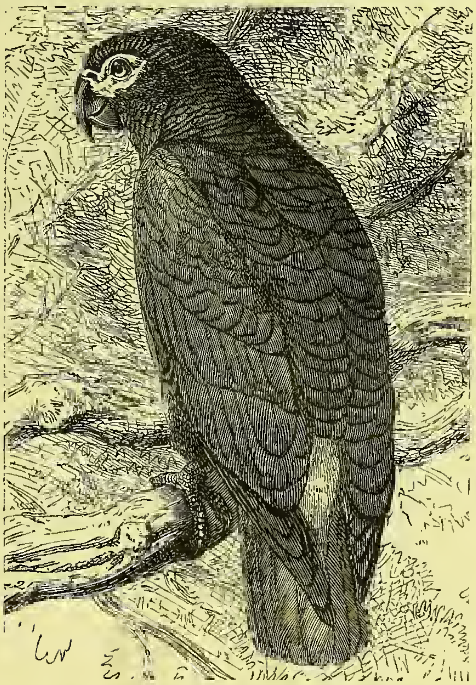
The splendid red, blue, and yellow macaws, so familiar to us in aviaries, belong to the genus Ara. The Blue-and-yellow Macaw (*Ara ararauna*) is in length about thirty-nine inches, the tail alone being about twenty-four. The bill is entirely black, very large and strong; the upper mandible measuring, from the forehead to the tip, three inches and a quarter. The cheeks are white and nearly naked, with three fine narrow striæ of small black plumes beneath the eyes. The irides are yellowish-white. Immediately beneath the under mandible is a broad black band, extending upwards to the ears, and encompassing the greater part of the naked white space. The whole of the upper plumage is of a beautiful rich blue, passing into green upon the forehead, crown, rump, and some of the smaller wing-coverts. The greater quills and tail are of a deeper tint, approaching to violet. The under surfaces of the wings and tail are yellow. The legs and feet are blackish-grey, the scales defined by whitish lines. Like all other members of the genus, it is a native of tropical America, and is met with in the Brazils, particularly upon the banks of the River Amazon, in Guiana, and Surinam. It prefers the woods, particularly such as occupy swampy grounds, and which abound in a species of palm, upon whose fruit it principally subsists. It is said generally to keep in pairs, though occasionally to assemble in large flocks, and when this is the case their united screams are heard to a great distance. They fly often at a high elevation, and accompanied by a variety of aerial evolutions, particularly before alighting, which is always upon the summits of the highest trees. They deposit their eggs, which never exceed two in number, in the hollow trunks of decayed trees, and generally have two broods in the year. Both sexes are reported to sit alternately upon the eggs, and to be equally assiduous in cherishing and conveying food to the young. When taken at an early age they are easily tamed; but their imitative powers are not equal to those of the grey parrot, and it is seldom that they can be taught to articulate clearly. Their natural notes are very unpleasant to the ear, consisting of loud and piercing screams, interrupted with hoarse, croaking murmurs.

The North American species, the Caroline Macaw (*Conurus carolinensis*), is described by Wilson as being found throughout Louisiana and the shores of the Mississippi and Ohio, and also those of their tributary waters as high as Lake Michigan, in latitude 42° N. We learn, however, from Audubon, that of late years these birds have rapidly diminished in number, and that they are now almost banished from districts where formerly they used to abound. "At that period," he says, speaking of five-and-thirty years ago, "they could be procured as far up the tributary waters of the Ohio as the great Kenhawa, the Scioto, the heads of the Miami, the mouth of the Maiumee at its junction with Lake Erie, on the Illinois river, and sometimes as far north-east as Lake Ontario, and along the eastern districts as far as the boundary line between Virginia and Maryland. At the present day few are to be found higher than Cincinnati, nor is it until you reach the mouth of the Ohio that they are to be met with in considerable numbers. I should think that along the Mississippi there is not now half the number that existed fifteen years ago." The Carolina macaws in all their movements, which are uniformly gregarious, show a peculiar predilection for the alluvial rich and dark forests bordering on the principal rivers and larger streams, in which the towering cypress and gigantic sycamore spread their vast summits, or stretch their innumerable arms over a wide waste of moving or stagnant waters. From these, the beech, and the hackberry, they derive an important supply of food. The flocks, moving in the manner of wild pigeons, dart in swift and airy phalanx through the green boughs of the forest; screaming in a general concert, they wheel in wide and descending circles round the tall button-wood, and all alight in the same instant, their green lustre, like the fairy mantle, rendering them nearly invisible beneath the shady branches, where they sit, perhaps arranging their plumage, and shuffling side by side seem to caress and scratch each other's heads, with all the fondness and unvarying friendship of affectionate doves.

The TRUE PARROTS, OR PSITTACIDÆ, have no crest. Their tail is short and square. They are among the best known of the group. Many of them are fine birds, and very docile. Their conversational powers are great, and many are the stories this talking power of theirs have given rise to.

The Grey Parrot (*Psittacus erythracus*) was probably the first true parrot brought to Europe. This well-known species, though not conspicuous for that brilliancy and variety of plumage which distinguishes the great majority of the tribe, is remarkable for its docility and mimicry; the faculty it possesses of imitating the human voice, as well as any other sound; its never-ceasing garrulity, and its clear and distinct articulation. In most of these particulars it surpasses the rest of its congeners, on which account it has always been held in high estimation by the bird-fancier and lover of living curiosities. This we learn from the large sums which have, at all times, been offered and paid for highly-gifted or well-taught individuals. Even as early as A.D. 1500, we read of a parrot at Rome, supposed to be of this species, for which one hundred pieces of gold were given by a cardinal, it having had, it is said, the power of repeating, with clearness and without hesitation, the whole of the Apostles' Creed.

Mr. Jesse tells us of one of these parrots at Hampton Court:—"I had seen and heard so much of it, that I requested the sister of its owner to furnish me with some particulars respecting it, and I now give the account in her own agreeable manner of stating it. I will only add, that its accuracy need not be doubted. 'As you wished me to write down whatever I could collect about my sister's wonderful parrot, I proceed to do so, only promising that I will tell you nothing but what I can vouch for having myself heard. Her laugh is quite extraordinary, and it is impossible not to help joining in it oneself, more especially when in the midst of it she cries out," Don't make me taugh so; I shall die, I shall die;" and then continues laughing more violently than before. Her crying and sobbing are curious; and if you say, "Poor Poll, what is the matter?" she says, "So bad, so bad; got such a cold;" and after crying for some time, will gradually cease, and making a noise like drawing a long breath, say, "Better now," and begin to laugh. The first time I ever heard her speak was one day when I was talking to the maid at the bottom of the stairs, and heard what I then considered to be a child call out, "Payne" (the maid's name), "I am not well, I am not well;" and on my saying, "What is the matter with that child?" she replied, "It is only the parrot; she always does so when I leave her alone, to make me come back;" and so it proved, for on her going into the room the parrot stopped, and then began laughing quite in a jeering way.



THE GREY PARROT. (*Psittacus erythracus.*)

"'It is singular enough, that whenever she is affronted in any way she begins to cry, and when pleased, to laugh. If any one happens to cough or sneeze, she says, "What a bad cold." One day, when the children were playing with her, the maid came into the room, and on their repeating to her several times things which the parrot had said, Poll looked up and said quite plainly, "No, I didn't." Sometimes, when she is inclined to be mischievous, the maid threatens to beat her, and she often says, "No, you won't." She calls the cat very plainly, saying, "Puss, puss," and then answers, "*Mew*"; but the most amusing part is, that whenever I want to make her call it, and to that purpose say, "Puss, puss," myself, she always answers, "*Mew*," till I begin mewing; and then she begins calling "Puss" as quick as possible. She imitates every kind of noise, and barks so naturally that I have known her to set all the dogs on the parade at Hampton Court barking, and I dare say, if the truth was known, wondering what was barking at them; and the consternation I have seen her cause in a party of cocks and hens, by her crowing and chuckling, has been the most ludicrous thing possible. She sings just like a child, and I have more than once thought it was a human being; and it is most ludicrous to hear her make what one should call a false note, and then say, "Oh, la!" and burst out laughing at herself, beginning again quite in another key. She is very fond of singing "Buy a broom," which she says quite plainly; but in the same spirit as in calling the cat, if we say, with a view to make her repeat it, "Buy a broom," she always says, "Buy a *brush*," and then laughs as a child might do when mischievous. She often performs a kind of exercise which I do not know how to describe, except by saying that it is like the lance exercise. She puts her claw behind her, first on one side and then on the other, then in front, and round over her head, and whilst doing so keeps saying, "Come on, come on!" and when finished, says, "Bravo, beautiful!" and draws herself up.'"

The Love Birds belong to the genus Psittacula. They receive their name from the soft, fond manners that they display to one another. They are natives of the warm, tropical regions of South America. The species we figure is often to be seen in captivity.

There are still three most remarkable genera of parrots, which must be mentioned together, though it is possible they should be formed into distinct families.

There are the parrots belonging to the genus Nestor. The Kaka Parrot (*Nestor hypopolius*) is a native of New Zealand; it has been brought living to England. Next the very rare and strange Dasyptilus pequetii, which is found in New Guinea and Lalwatty. Mr. Allen, who was Mr. Wallace's assistant, once saw a specimen in the possession of a Bugis trader, and lastly, the curious Night Parrot of New Zealand (*Strigops habroptilus*), called the Kakapo, which lives, writes Dr. Lyall, in holes under the roots of trees; it is also occasionally found under shelving rocks. The roots of many New Zealand trees growing partly above ground, holes are common under them; but where the kakapo is found, many of the holes appeared to have been enlarged, although no earth was ever found thrown out near them. There were frequently two openings to these holes, and occasionally, though rarely, the trees over them were hollow for some distance up.

LOVE BIRDS (*Psittacula passerina*).

The only occasion on which the kakapo was seen to fly was when it got up one of these hollow trees, and was driven to an exit higher up. The flight was very short, the wings being scarcely moved; and the bird alighted on a tree at a lower level than the place from whence it had come, but soon got higher up by climbing, using its tail to assist it. Except when driven from its holes, the kakapo is never seen during the day, and it was only by the assistance of dogs that we were able to find it.

Before dogs became common, and when the bird was plentiful in inhabited parts of the islands, the natives were in the habit of catching it at night, using torches to confuse it. It offers formidable resistance to a dog, and sometimes inflicts severe wounds with its powerful claws and beak. At a very recent period it was common all over the west coast of the Middle Island; but there is now a race of wild dogs said to have overrun all the northern part of this shore, and to have almost extirpated the kakapos wherever they have reached. Their range is said to be at present confined by a river or some such physical obstruction; but it is to be feared that if they once succeed in gaining the stronghold of the kakapo (the south-west end of the island), the bird may soon become extinct.

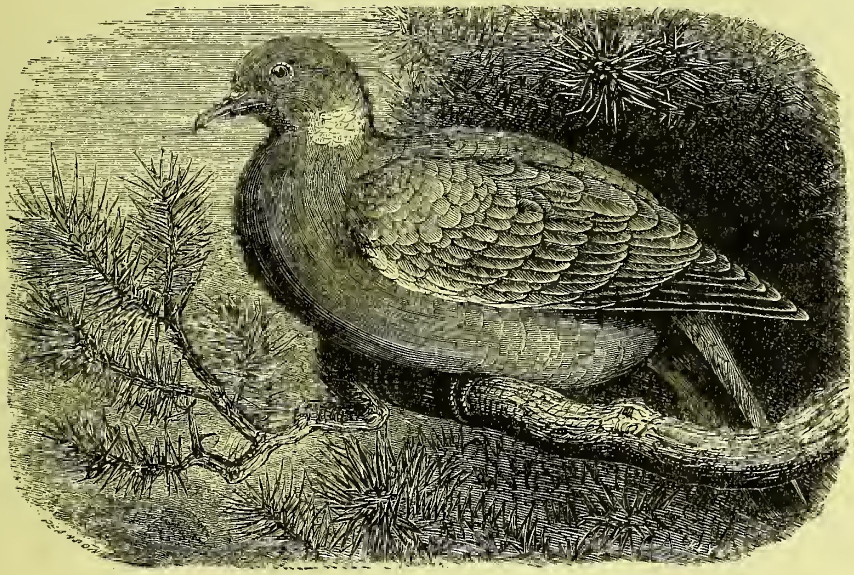
During the latter half of February and the first half of March, whilst we were amongst the haunts of these birds, we found young ones in many of the holes, frequently only one, never more than two, in the same hole. In one case where there were two young ones, I found also an addled egg. There was usually, but not always, an old bird in the same hole with the young ones.

They build no nest, but simply scrape a slight hollow amongst the dry dust formed of decayed wood. The young were of different ages, some being nearly fully fledged, and others covered only with down. The egg is white, and about the size of a pigeon's.

The cry of the kakapo is a hoarse croak, varied occasionally by a discordant shriek, when irritated or hungry. The Maories say that during winter they assemble together in large numbers in caves; and at the time of meeting, and again before dispersing to their summer haunts, that the noise they make is perfectly deafening.

ORDER IV.—PIGEONS (*Columbæ*).

The Pigeons and Doves form a well-marked order of birds, showing some affinity both to the Perchers and to the Gallinaceous birds. Their bill is peculiar. The upper mandible is arched towards the apex, and is again convex towards the base, where it forms a cartilaginous plate, which covers the nasal cavities, and in which the nostrils are pierced. The skin covering this part is sometimes smooth, at other times rough; sometimes it is fleshy, and again warty. The gullet widens into a large crop, which is double; and during the breeding season it secretes a milky juice which, mixing with the food in the crop, softens it, and this it is which is regurgitated by the old birds into the mouths of their young.



RING DOVE OR CUSHAT (*Columba palumbus*).

Their plumage differs from the gallinaceous birds by the absence of accessory feathers. Though more or less arboreal in their habits, most of them seek their food on the ground, on which they can walk swiftly and with ease; their flight is very strong. In their method of drinking they differ from all other birds, taking deep long draughts until satisfied, with their bills immersed in the fluid, and not swallowing, as other birds do, with uplifted beaks. They build their nests in trees or in the holes of rocks; very rarely on the ground. Their voice is a plaintive cooing; but this varies into almost a whistle in some of the ground doves. They are mostly birds of moderate size, but the Great Ground Pigeons of New Guinea are nearly as large as turkeys.

Of the family Columbidæ, upwards of 360 species are known, and so many of these are peculiar to small isolated islands in which few beasts of prey are found, as to prove that these birds require for their existence great freedom from danger. Some of the loveliest coloured species of this family belong to the genus Treron; but space forbids us to do more than just mention the Cushat (*Columba palumbus*), which in Britain is distributed from one extremity of the kingdom to the other, residing permanently with us; for though subject to a partial movement upon the approach of winter, when the various individuals scattered over the country collect together and form extensive flocks, no actual migration takes place, but these congregated masses still keep within their respective districts. The magnitude of these winter flocks has, no doubt, suggested the idea that a migration from distant climes to this country annually takes place at this season of the year, and that the numbers of our native stock are thus augmented. We see no necessity, however, for supposing this to be the case, nor is it authorised by any observed or established fact. The species in districts favourable to its increase appears to be sufficiently numerous to account for the largest bodies seen assembled together.

DOMESTIC PIGEONS (*Columba livia*).

This congregation of the ring-pigeons takes place towards the end of October or beginning of November, at which time all the autumnal broods have become fully fledged, and they remain thus until the beginning of February, when the first mild days and the genial influence of the ascending sun will call forth those instinctive feelings which urge them to separate and pair, and each to seek an appropriate retreat for the rearing of a future brood. At first, when thus congregated, they haunt the stubbles, or districts producing an abundance of beech-mast or acorns, the woods, and trees; but as these resources become exhausted they resort to the turnip-fields, the leaves and tops of which root they greedily devour. This food now constitutes their principal support during the winter and early spring months, or until the clover begins to sprout and the seed-corn is committed to the earth;

and it has been observed that the increase of the species has been progressive with that of the culture of this valuable root. The numerous and extensive plantations that of late years have been so generally made throughout the island, and which in a young and close-growing state are peculiarly favourable to its habits, must also be taken into account, and perhaps these tend in an equal degree to the cause above assigned to the rapid increase of its numbers. When thus united they repair to their feeding-ground early in the morning, and again in the afternoon before they retire to roost, the middle of the day being passed in repose or digesting their first meal upon the nearest trees. When thus perched, some are always on the watch, and so great is their vigilance that it is almost impossible by any device to get within gun-shot. In the evening they retire to the woods to roost, preferring those of the fir tribe and ash to any other, and in these nocturnal retreats great slaughter is sometimes committed by waiting in concealment their arrival, which regularly takes place immediately after sunset.

The first mild weather in February produces an immediate effect upon these congregated pigeons, and we may almost calculate to a day when their cooing and plaintive murmurs will again be heard in their wonted summer haunts.

The Turtle Dove (*Turtur communis*) is a yearly visitor of Great Britain, being found as far north as Morayshire, and on one occasion it has been shot in one of the Orkney Islands. It is common in Holland and Switzerland, and indeed all through the Continent.

Of the other British species must be mentioned the Stock Dove (*C. œnas*) and the Rock Dove (*C. livia*), which is the original of our domestic varieties. These Mr. Darwin groups as follows :—

Group 1 . . .	English Carrier. Runt. Barb.
Group 2 . . .	Fantail. African Owl. Short-faced Tumbler. Indian Frill-back. Jacobin.
Group 3 . . .	English Pouter.
Group 4 . . .	Dove Cot Pigeon. Swallow. Spot. Nun. English Frill-back. Laugher. Trumpeter.

The Passenger Pigeon (*Ectopistes migratorius*) is thus described by Wilson :—"Its roosting-places are always in the woods, which sometimes occupy a large extent of forest. When these birds have frequented one of these places for some time the appearance it exhibits is surprising. The ground is covered, to the depth of several inches, with their dung; all the tender grass and underwood are destroyed; the surface is strewed with large limbs of trees, broken down by the weight of the birds collecting one above the other; and the trees themselves for thousands of acres killed as completely as if girded by an axe. The marks of their desolation remain for many years on the spot, and numerous such-like places could be pointed out. For several years after scarcely a vegetable made its appearance. When these roosts are first discovered, the inhabitants from a considerable distance visit them in the night, with guns, clubs, long poles, pots of sulphur, and various engines of destruction. In a few hours they fill many sacks, and load horses with them. By the Indians a pigeon roost or breeding-place is considered an important source of national profit and dependence for that season, and all their active ingenuity is exercised on the occasion. The breeding-places differ from the roosting-places in their greater extent. In the Western countries, as the States of Ohio, Kentucky, and Indiana, these are generally in backwoods, and extend in nearly a straight line across the country for a great way. Not far from Shelbyville, in the State of Kentucky, some years ago, there was one of these breeding-places which stretched through the woods in nearly a north and south direction, was several miles in breadth, and was said to be upwards of fifty miles in extent. In this tract almost every tree was furnished with nests wherever the branches could accommodate them.

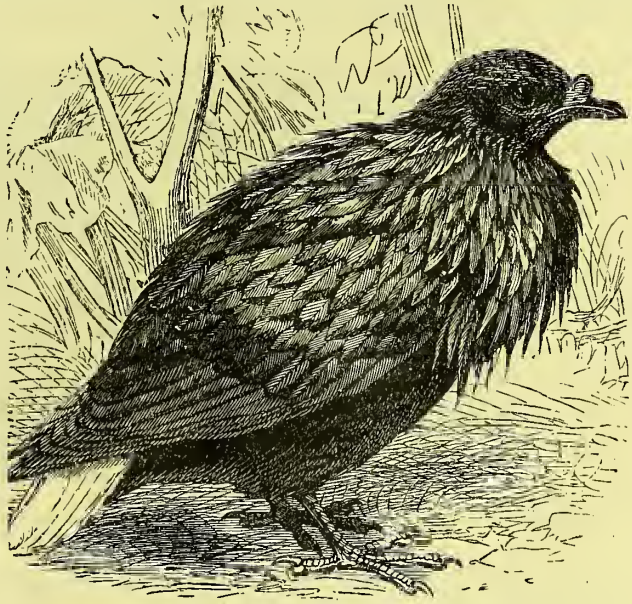
"The pigeons made their first appearance there about the 10th of April, and left it altogether with their young before the 25th of May. As soon as the young were fully grown, and before they left the nests, numerous parties of the inhabitants, from all parts of the adjacent country, came with wagons, axes, beds, and cooking utensils, many of them accompanied by the greater part of their families, and encamped for several days at this immense nursery. Several of them stated that the noise was so great as to terrify their horses, and that it was difficult for any person to hear another speak without bawling in his ear. The ground was strewed with broken limbs of trees, eggs, and young squab pigeons, which had been precipitated from above, and on which herds of hogs were fattening. Hawks, buzzards, and eagles were sailing about in great numbers, and seizing the squabs from the nests at pleasure, while, from twenty feet upwards to the top of the trees, the view through the woods presented a perpetual tumult of crowding and fluttering multitudes of pigeons, their wings roaring like thunder, mingled with the frequent crash of falling timber: for now the axemen were at work cutting down those trees that seemed to be most crowded with nests, and contriving to fell them in such a manner, that in their descent they might bring down several others; by which means the falling of one large tree sometimes produced two hundred squabs, little inferior in size to the old ones, and almost one heap of fat. On some single trees upwards of one hundred nests were found, each containing one squab only, a circumstance in the history of this bird not generally known to naturalists. It was dangerous to walk under these flying and fluttering millions, from the frequent fall of large branches, broken down by the weight of the multitudes above, and which in their descent often destroyed numbers of the birds themselves; whilst the clothes of those engaged in traversing the woods were completely covered with the excrements of the pigeons." These circumstances were related to Wilson by many of the most respectable portion of the community in that quarter, and were confirmed in part by what he himself witnessed. "I passed," he says, "for several miles through this same breeding-place, where every tree was spotted with nests, the remains of those above described. In many intances I counted upwards of ninety nests on a single tree; but the pigeons had abandoned this place for another, sixty or eighty miles off, towards Green River, where they were said at that time to be equally numerous. From the great numbers that were constantly passing over our heads to and from that quarter I had no doubt of the truth of this statement. The mast had been chiefly consumed in Kentucky; and the pigeons every morning, a little before sunrise, set out for the Indiana territory, the nearest part of which was about sixty miles distant. Many of these returned before ten o'clock, and the great body generally appeared on their return a little after noon. I had left the public road to visit the remains of the breeding-place near Shelbyville, and was traversing the woods with my gun on my way to Frankfort, when, about ten o'clock, the pigeons which I had observed flying the greater part of the morning northerly, began to return in such immense numbers as I never before had witnessed.

PASSENGER PIGEONS (*Ectopistes migratoria*).

"Coming to an opening by the side of a creek called the Benson, where I had a more uninterrupted view, I was astonished at their appearance: they were flying with great steadiness and rapidity, and at a height beyond gun-shot, in several strata deep, and so close together that, could shot have reached them, one discharge could not have failed of bringing down several individuals. From right to left, as far as the eye could reach, the breadth of this vast procession extended, seeming everywhere equally crowded. Curious to determine how long this appearance would continue, I took out my watch to note the time, and sat down to observe them. It was then half-past one. I sat for more than an hour; but, instead of a diminution of this prodigious procession, it seemed rather to increase, both in numbers and rapidity; and, anxious to reach Frankfort before night, I rose and went on. About four o'clock in the afternoon I crossed Kentucky River, at the town of Frankfort, at which time the living torrent above my head seemed as numerous and as extensive as ever. Long after this I observed them in large bodies that continued to pass for six or eight minutes, and these again were followed by other detached bodies, all moving in the same south-east direction till after six in the evening. The great breadth of front which this mighty multitude preserved would seem to intimate a corresponding breadth of their breeding-place, which, by several gentlemen who had lately passed through part of it, was stated to me at several miles."

Wilson then enters into a rough calculation of the numbers of this mass, and he comes to the conclusion that its whole length was 240 miles, and that the numbers composing it amounted to 2,230,272,000 pigeons, observing that this is probably far below the actual amount. He adds that, allowing each pigeon to consume half-a-pint of food daily, the whole quantity would equal 17,424,000 bushels daily. Audubon confirms Wilson in every point, excepting that he very properly corrects that part of the narrative which would lead to the conclusion that a single young bird only is hatched from each nest.

The Nicobar Pigeon (*Callœnas nicobarica*) is found in the Nicobar and Philippine Islands and in New Guinea. Mr. Wallace tells us that, "On the last day of my stay here one of my hunters succeeded in finding and shooting the beautiful Nicobar pigeon, of which I had been so long in search. None of the residents had ever seen it, which shows that it is rare and shy. My specimen was a female, in beautiful condition, and the glossy coppery and green of its plumage, the snow-white tail and beautiful pendent feathers of the neck, were greatly admired. I subsequently obtained a specimen in New Guinea, and once saw it in the Kaióa Islands. It is found also in some small islands near Macassar, in others near Borneo, and in the Nicobar Islands, whence it receives its name. It is a ground feeder, only going upon trees to roost, and is a very heavy, fleshy bird. This may account for the fact of its being found chiefly on very small islands, while in the western half of the archipelago it seems entirely absent from the larger ones. Being a ground feeder it is subject to the attacks of carnivorous quadrupeds, which are not found in the very small islands. Its wide distribution over the whole length of the archipelago, from extreme west to east is, however, very extraordinary, since, with the exception of a few of the birds of prey, not a single land bird has so wide a range. Ground feeding birds are generally deficient in power of extended flight, and this species is so bulky and heavy that it appears at first sight quite unable to fly a mile. A closer examination shows, however, that its wings are remarkably large: perhaps, in proportion to its size, larger than those of any other pigeon, and its pectoral muscles are immense. A fact communicated to me by the son of my friend, Mr. Dnivenboden, of Ternate, would show that, in accordance with these peculiarities of structure, it possesses the power of flying long distances. Mr. Dnivenboden established an oil factory on a small coral island, a hundred miles north of New Guinea, with no intervening land. After the island had been settled a year, and traversed


THE NICOBAR PIGEON (*Callœnas nicobarica*).

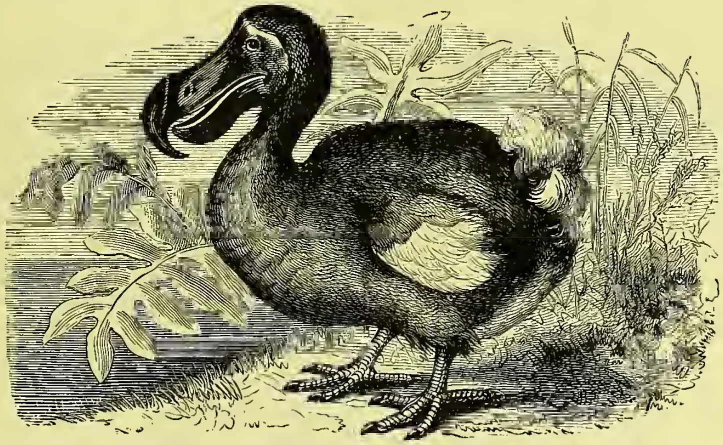
in every direction, his son paid it a visit, and just as the schooner was coming to an anchor a bird was seen flying from seaward, which fell into the water exhausted before it could reach the shore. A boat was sent to pick it up, and it was found to be a Nicobar pigeon, which must have come from New Guinea, and flown a hundred miles, since no such bird previously inhabited the island. This is certainly a very curious case of adaptation to an unusual and exceptional necessity. The bird does not ordinarily require great powers of flight, since it lives in the forest, feeds on fallen fruits, and roosts in low trees like other ground pigeons. The majority of the individuals, therefore, can never make full use of their enormously powerful wings, till the exceptional case occurs of an individual being blown out to sea, or driven to emigrate by the incursion of some carnivorous animal or the pressure of scarcity of food. A modification, exactly opposite to that which produced the wingless birds (the Apteryx, Cassiowary, and Dodo), appears to have here taken place, and it is curious that in both cases an insular habitat should have been the moving cause. The explanation is, probably, the same as that applied by Mr. Darwin to the case of the Madeira beetles, many of which are wingless, while some of the winged ones have the wings better developed than the same species on the continent. It was advantageous to these insects either never to fly at all, and thus not run the risk of being blown out to sea, or to fly so well as to be able either to return to land or to migrate safely to the continent. Bad flying was worse than not flying at all. So while, in such islands as New Zealand and Mauritius, far from all land, it was safer for a ground feeding bird not to fly at all, and the short-winged individuals continually surviving, prepared the way for a wingless group of birds. In a vast archipelago, thickly strewn with islands and islets, it was advantageous to be able occasionally to migrate, and thus the long and strong-winged varieties maintained their existence longest, and ultimately supplanted all others, and spread the race over the whole archipelago."

THE CROWNED GOURA (*Goura coronata*).

The magnificent Great Crowned Pigeon (*Goura coronata*) is found in New Guinea, and is the largest bird in this order.

The strange Hook-billed Ground Pigeon (*Didunculus strigirostris*) might well form a family in itself. It has been by some referred to the birds of prey; it is only found in the Samoan Islands, from whence it has been brought once or twice living to London. About one of these birds sent to the Zoological Gardens by Mr. Whitmee, he writes: "It is a young bird, which I purchased in June last. It was then just from the nest, and unfledged. It must have been hatched in May. This proves the breeding season to be earlier in the year than I previously thought it was. I once procured an unfledged bird in September, and I have seen several young ones about in September and October: so we may safely regard the breeding season as extending from May to September. We fed the Didunculus for more than a month by placing small pieces of bread-fruit, taro-bread, &c., in its mouth, which was always open for the reception of contributions when any one was near it. In a little more than a month it began to peck for itself. It is now almost an omnivorous feeder. The first plumage was a mottled brown, almost black. The teeth in the bill were scarcely perceptible. The bird looked so little like the adult Didunculus when I bought it that it was pronounced by some gentlemen on board one of H.M. men-of-war, which was in port, and also by some residents here, to be a different bird. This was fortunate for me, for it was taken to the said naval zoologists before it was offered to me, in the hope of getting a higher price from them than I would give.

"The plumage, legs, and back of the bird are now assuming the colours of the adult state; but I think they will not be fully developed until the bird is a year old, for I previously kept one ten months from the nest, and it was not then perfectly developed. I believe the bird I now have is a male. It is exceedingly savage. When any one approaches its cage it ruffles its feathers, trembles apparently with rage, and tries to bite. If it gets hold of one's finger, I know from experience that it gives a severe gripe. The one I previously kept was just as savage. This one is in a cage alone that was in a large aviary with a number of other birds, and was lord of the place: would only allow them to feed when it had finished, and drove them about in a very savage manner.



THE DODO (*Didus ineptus*).

"It strikes me that the Didunculi are increasing in numbers. Long ago the Samoans used to 'preserve' them. A chief would have a hut in the bush, not far from his house, where the birds were fed daily; they were then very numerous and very tame. The introduction of cats (and I believe also rats) by European vessels led almost to the extinction of the bird. But within a recent period it must have increased considerably. Only a few years ago I had a native on the search for a Didunculus for months before he found one. Now the same native will go into the bush any day and almost certainly find at least one. Something may be allowed for a knowledge of the haunts of the bird, but this will not wholly account for the comparative ease with which it may now be found. I believe the habit of the bird has in a great measure changed: that instead of feeding almost exclusively upon high trees, it now roosts and builds higher than formerly. I have questioned the natives who have brought me birds, and the almost uniform testimony is in favour of this view. Hence 'natural selection' seems now to be operating for the preservation of this once almost extinct bird."

Here, perhaps, we should refer to the lost Dodo (*Didus ineptus*). The birds, writes Mr. Wallace, which constitute this family (DIDIDÆ) are now all extinct; but as numerous drawings are in existence, taken from living birds, some of which were exhibited in Europe, and a stuffed specimen, fragments of which still remain, was in the Ashmolean Museum at Oxford down to 1755, they must be classed among recent, as opposed to geologically extinct species. The dodo, a large, unwieldy, flightless bird, inhabited Mauritius down to the latter part of the seventeenth century; and an allied form, the Solitaire (*Pezophaps solitaria*), was found only in the island of Rodriguez, where it survived about a century later. Old voyagers mention a dodo also in Bourbon, and a rude figure of it exists, but no remains of this bird have been found. Almost complete skeletons of the dodo and solitaire have, however, been recovered from the swamps of the Mauritius and the caves of Rodrigues, proving that they were both extremely modified forms of pigeons.

These large birds were formerly very abundant, and being excellent eating and readily captured, the early voyagers to these islands used them largely for food. As they could be caught by man, and very easily by dogs, they were soon greatly diminished in numbers; and the introduction of swine, which ran wild in the forests and fed on the eggs of young birds, completed their extermination.

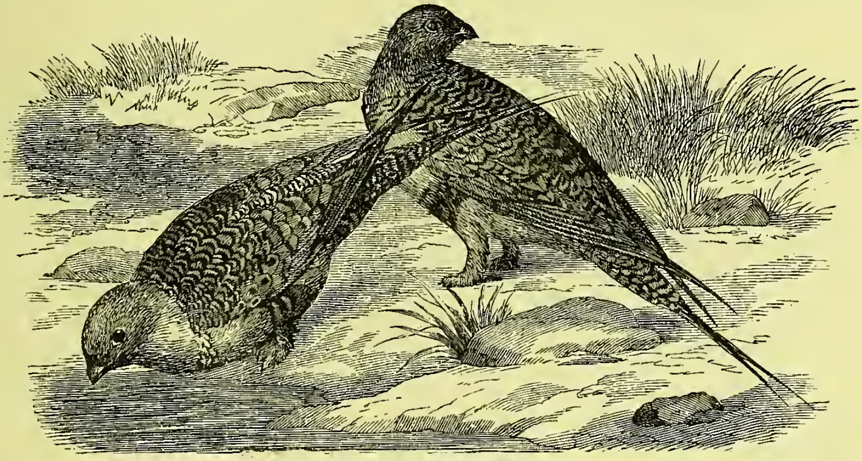
The existence in the Mascarene Islands of a group of such remarkable terrestrial birds with aborted wings is parallel to that of the Apteryx and Dinornis in New Zealand, the Cassiowaries of Austro-Malaya, and the Short-winged Rails of New Zealand, Tristan D'Acunha, and other oceanic islands; and the phenomenon is clearly dependent on the long-continued absence of enemies, which allowed of great increase of bulk and the total loss of the power of flight without injury. In some few cases (the ostrich, for example) birds incapable of flight co-exist with large carnivorous mammalia; but these birds are large and powerful, as well as very swift, and are thus able to escape from some enemies and defend themselves against others.

The entire absence of the smaller and more defenceless ground birds from the adjacent island of Madagascar is quite in accordance with this view, because that island has several small but distinctive carnivorous animals.

THE DINORNIS.

ORDER V.—THE FOWLS (*Gallinæ*).

THIS order includes all those birds that agree more or less in structure with our domestic Fowl (Gallus), and the name of Rasores or Scrapers is often given to it from the habit these birds have of scratching up the ground in search of food. Mostly of moderate size, there are no very small birds in this order. Their bodies are stout, and neck short. The legs are usually short and stout, with the tibiæ feathered; and in some cases the feathers extend over the tarsi and even over the toes. The toes are furnished with blunt nails; the hinder toe is raised a little; the male birds frequently have spurs on the back of the tarsus. The plumage is firm, and the accessory plumules are always present, and are of large size. The plumage of the male birds is sometimes extremely magnificent. The wings are generally short, and their flight is not powerful or prolonged. The well-known whirring sound made by these birds in flying is indeed characteristic of the order. They live on hard seeds and fruits, and have a very strong gizzard. They generally build their nests on the ground, though the birds often roost in trees. They are mostly polygamous in their habits, the male birds being usually surrounded by a troop of hen birds. With a remarkable exception, the whole business of incubation is left to the hen birds. The young can run about as soon as hatched, and resort to the shelter of their mother's wings for safety. There are about 400 species known.



SAND GROUSE (*Syrrhaptes paradoxa*).

Commencing with the Sand Grouse, which forms the family PTEROCLIDÆ, we find a group of neatly-shaped birds, with long pointed tails and a wonderfully varied plumage, suited to hide the bird from observation while living in the open barren plains of Central Asia. One of these birds, Syrrhaptes paradoxa, though normally inhabiting Tartary and Tibet, in 1866 suddenly appeared all over Western and Northern Europe, some few specimens reaching to Ireland and the Faro Islands.

The next family, that of the TETRAONIDÆ, includes the grouse, partridges, and quails.

The Capercaillie (*Tetrao urogallus*) is supposed to have been an inhabitant of the British Isles within the last century. It is still to be found in most parts of the Scandinavian Peninsula—indeed, as far to the north as the fir-tree flourishes, which is very near to the North Cape itself. It is, however, more scarce in the more southern of the Swedish provinces. Its favourite haunts are extensive fir-woods; in coppices or small cover it is seldom or never found. The birds which breed in the larger forests remain there all the year round; but those which breed on elevated mountains, the summits of which are destitute of trees, or on a more open part of the country, in the event of deep snow, usually come down to the lower grounds.

The principal food of the capercaillie, in its natural state, consists of the leaves of the Scotch fir. It also eats juniper-berries, cranberries, blueberries, and other berries common to the northern forests, and occasionally also, in winter time, the buds of the birch, &c. It very rarely feeds on the leaves of the spruce. The young birds feed chiefly, at first, on ants and other insects, as well as worms.

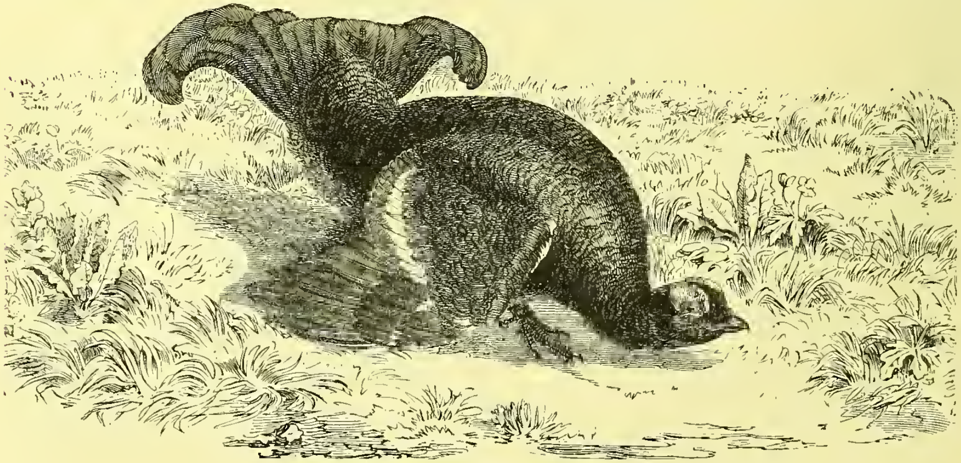
THE CAPERCAILLIE (*Tetrao urogallus*)

These birds live to a considerable age. The cocks do not attain their full growth until their third year or upwards. The older ones may be easily known from their greater bulk, their eagle-like bill, and the more beautiful glossiness of their plumage. The size of these birds appears to depend in a great degree on the latitude where they are found. In Lapland, for instance, the cocks (the hens being much smaller) seldom exceed nine or ten pounds. In Wermeland and adjacent parts, Mr. Lloyd never heard of them exceeding thirteen pounds; whilst in the more southern provinces of Sweden they have not unfrequently been met with weighing seventeen pounds and upwards. The hen capercaillie usually weighs from five to six pounds.

The Black Grouse (*Tetrao tetrix*) is met with in uncultivated wastes which are covered with heath and juniper. It feeds on the mountain and bog berries, and when they are scarce, on the tops of heath. This bird abounds in North Wales and the Highlands of Scotland, and they are found in the southern parts of England.

The Prairie Grouse (*T. cupido*), from North America, is often to be seen during the season in great quantities in the London markets.

The Red Grouse (*Lagopus scoticus*) is a handsome species, and though called by Latham Scoticus, is worthy of a more general appellation. It is found in Scotland, in the North of England, in Wales, and in Ireland. It is, however, especially abundant in Scotland. Mr. Macgillivray says that the low sandy heaths of the eastern counties of the middle division appear to be less favourable to it than the more moist peaty tracts of the western and northern districts, where the shrubs on which it feeds attain a greater size

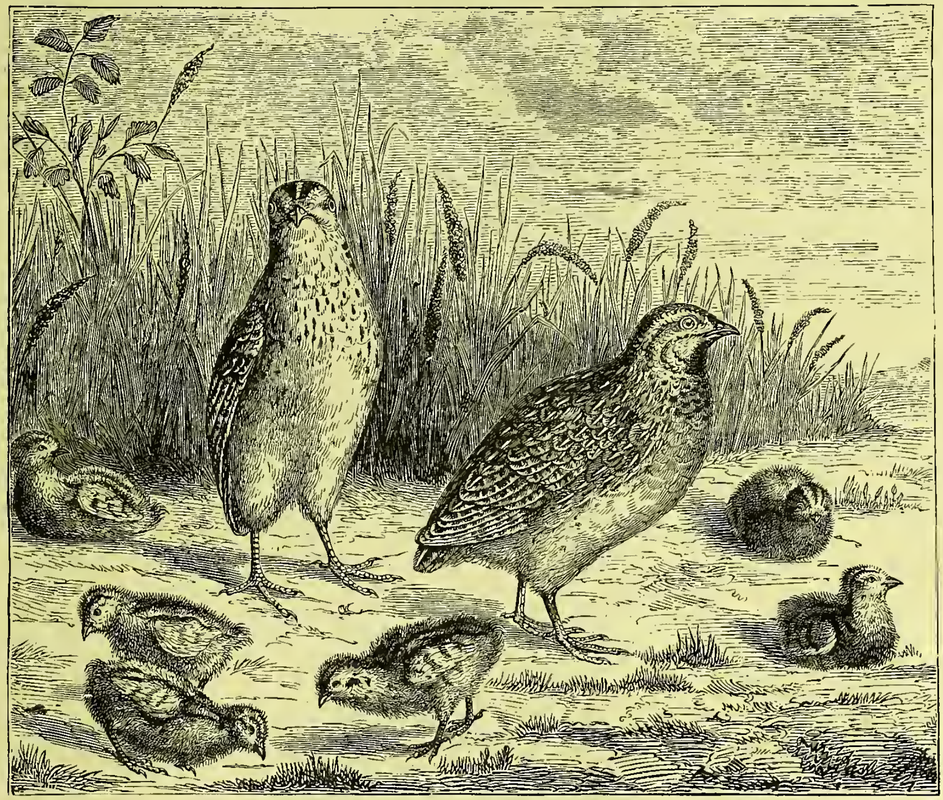


THE BLACK GROUSE (*Tetrao tetrix*).

In the central and desolate regions of the Grampians it is equally abundant as on the moors of the Hebrides; and on the hilly ranges of the south, the Pentlands, the Lammermuir, the mountains of Peebles, Dumfries, and Selkirk, and the moors of the North of

England, it is still plentiful. A depression of the ground, sheltered by a tuft of heather, suffices for a nest, which is formed of the stems of ling and grass, with occasionally a few feathers. The eggs are from eight to fourteen or fifteen in number, of a reddish-white ground-colour, nearly covered with brown blotches and spots.

The Ptarmigan (*L. mutus*) is not only a native of Scotland, but of the higher latitudes of Continental Europe. In Scotland—a comparatively temperate climate—the bare and bleak mountains are the permanent abode of the species there indigenous. While under the intense severity of winter within the Polar Circle, they all quit the more exposed situations: they seek the willows and copse-woods which border the rivers and stretch over the sheltered vales. Mountain berries and heath shoots in summer, spring buds and leaves in winter, constitute their food, in search of which, as well as for the sake of shelter, they burrow beneath the snow.



THE COMMON QUAIL (*Coturnix communis*).

Perhaps the change of plumage in none of the feathered tribes are more worthy of attention than those the ptarmigans undergo. Their full summer plumage is pure yellow, more or less inclining to brown, beautifully barred with zig-zag stripes of black. Their winter plumage is pure white, except that the outer tail-feathers, the shafts of the quills, and, in our species, a streak from the eye to the beak, are black.

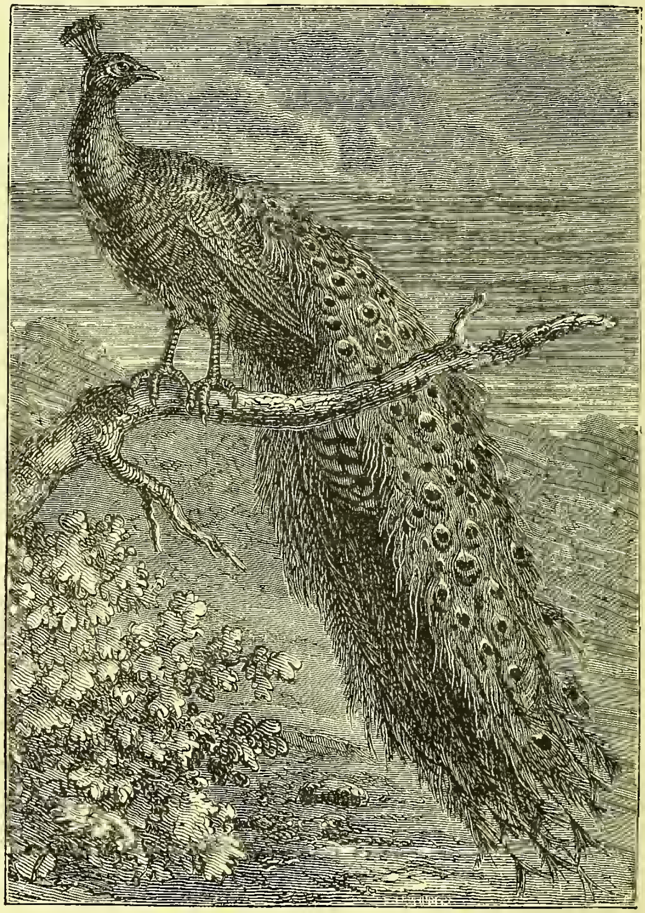
The Common Quail (*Coturnix communis*) is smaller than the partridge, being only about seven inches in length. It, however, resembles that bird in its form and modes of life, and its flesh is excellent. It is widely spread, being found throughout the whole of southern and temperate Europe and the greater part of Asia and Africa, but is everywhere migratory. The female makes an artless bed in a slight hollow of the ground for her eggs, which are of a green tint, and vary in number from eight to twelve, or even fifteen. In England the quail makes its appearance in May, but not in such great abundance, it is said, as formerly. In October it departs to Africa, which is the great winter abode of this species.

We can only allude by name to the pretty Californian Quail (*Callipepla californica*), the Virginian Colin (*Ortyx virginianus*), and the Greek Partridge (*Caccabis saxatilis*).

The Family PHASIANIDÆ includes the pea-fowl, pheasants, jungle-fowl, the turkeys, and the guinea-fowl. The reader who wishes to see the wonderful colouring of the birds belonging to this family should look over the magnificent illustrations given in Mr. Elliot's monograph of the family. Here space forbids us to do more than instance a bird here and there out of the eight sub-families Mr. Elliot divides it into.

The Common Pea-fowl (*Pavo cristatus*) is mentioned by Aristophanes as the "Persian peacock," and Suidas calls the peacock "the Median bird." In the Scriptures it is enumerated among the costly articles imported by the ships of Tarshish, employed by Solomon to enrich his country with the remarkable products of foreign nations. The fleet of the Hebrew monarch might easily procure it either from India or Persia. From Persia it was gradually diffused through India, Egypt, Greece, and Europe.

Colonel Williamson, in his account of peacock shooting, states that he has seen, about the passes of the Jungletery district, surprising quantities of wild pea-fowls. Whole woods were covered with their beautiful plumage, to which the rising sun imparted additional brilliancy. Small patches of plain among the long grass, most of them cultivated, and with mustard then in bloom, which induced the birds to feed, increased the beauty of the scene. "I speak within bounds," continues the colonel, "when I assert that there could not be less than twelve or fifteen hundred pea-fowls, of various sizes, within sight of the spot where I stood for near an hour."



THE PEACOCK (*Pavo cristatus*).

According to the same authority, it is easy to get a shot in the jungle; but when the birds flock together—which they do to the amount of forty or fifty—there was greater difficulty. Then they are not easily raised, and run very fast—so fast, that the colonel doubts whether a slow spaniel could make them take wing. They fly heavy and strong, generally within an easy shot; if winged only, they usually escape, from their swiftness of foot. They roost on high trees, into which they fly towards dusk.

Until the second year, the male and female have the same plumage. In the third year, the long dorsal plumes of the males begin to appear, and it is then that these birds begin to whirl about the tail, and to court the attention of the females. The pea-hen does not begin to lay till the third year.

The Black-winged Pea-fowl (*P. nigripennis*, Sclater) comes from Cochin China; and another species (*P. muticus*) is found in Java.

The Peacock Pheasant (*Polyplectron chinquis*) is a native of Burmah; and the magnificent Argus Pheasant (*Argus giganteus*) is found in Malacca.

Of the Lophophore pheasants, the following fine species may generally be seen in the London Zoological Gardens:—Lophophorus impeyanus, from the Himalaya Mountains; Ceriornis satyra, from South-eastern Himalaya; and C. temmincki, from China; also several species of the genus Pucrasia, from North-western China.

THE ARGUS PHEASANT (*Argus giganteus*).

Of the true Pheasants we find room to mention the Common Pheasant (*Phasianus colchicus*). This is a native of the British Islands. Their food, in a wild state, consists of grain-seeds, green leaves, insects, and ripe fruit. Mr. Selby says that the root of the common butter-cup is also much sought after by the pheasant; and Mr. Yarrell testifies to having found their crops "distended with acorns of so large a size that they could not have been swallowed without difficulty."

The Golden Pheasant (*Thaumalea picta*) is a native of China. In our country this bird has hitherto been preserved only in aviaries, where it is shielded from the cold of winter and supplied with food. In captivity it breeds freely. It is one of a race remarkable for beauty.

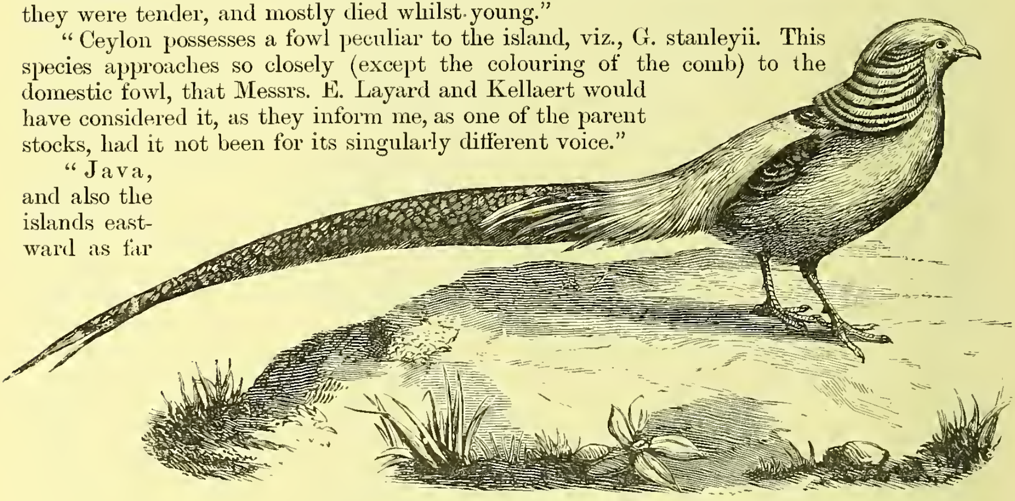
The golden pheasant is much smaller than the common one. The length of the male is about three feet, of which the tail measures twenty-three inches. The head is ornamented with a beautiful silky crest of a fine amber-yellow. The feathers of the back of the head and neck are of a rich orange-red, edged with a line of black, and capable of being raised at will. Lower down, the feathers whch lie on the top of the back are glossy greenish-black. The back is of a rich yellow colour; the wings deep blue at their base, the under surface intense scarlet.

Another species of surpassing beauty is Lady Amherst's Pheasant (*Th. amherstia*). It is a native of China.

Of the true Jungle-fowl, belonging to the genus Gallus, there are only four species. the supposed ancestor of our common fowl being G. bankiva. On the authority of Mr.

Darwin, we find "that the G. sonneratii does not range into the northern parts of India; according to Colonel Sykes, it presents, at different heights on the Ghauts, two strongly-marked varieties, perhaps deserving to be called species. It was at one time thought to be the primitive stock of all our domestic breeds, and this shows that it closely approaches the common fowl in general structure; but its hackles partly consist of highly peculiar, horny laminæ, transversely banded with three colours; and I have met with no authentic account of any such character having been observed in any domestic breed. This species also differs greatly from the common fowl, in the comb being finely serrated, and in the loins being destitute of true hackles. Its voice is utterly different. It crosses readily in India with domestic hens; and Mr. Blyth raised nearly one hundred hybrid chickens; but they were tender, and mostly died whilst young."

"Ceylon possesses a fowl peculiar to the island, viz., G. stanleyii. This species approaches so closely (except the colouring of the comb) to the domestic fowl, that Messrs. E. Layard and Kellaert would have considered it, as they inform me, as one of the parent stocks, had it not been for its singularly different voice."


THE GOLDEN PHEASANT (*Thaumalea picta*).

"Java, and also the islands eastward as far as Flores, are inhabited by G. varius (or furcatus), which differs in so many characters—green plumage, unserrated comb, and single median wattle—that no one supposes it to have been the parent of any one of our breeds."

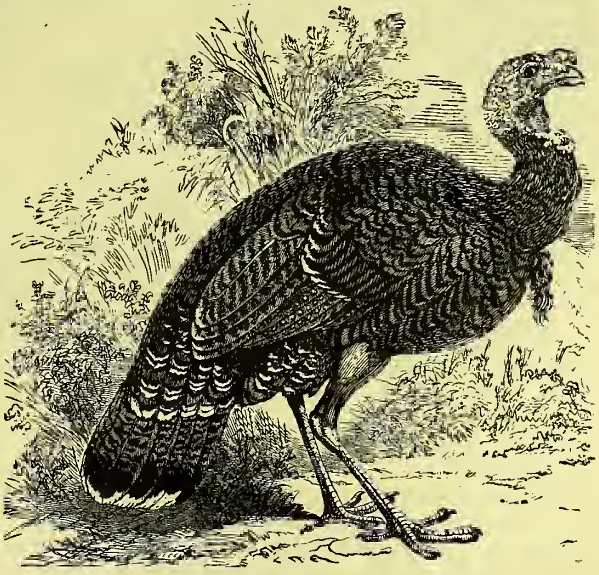
"The last species to be mentioned, namely, Gallus bankiva, has a much wider geographical range than the three previous species; it inhabits Northern India as far west as Sinde, and ascends the Himalaya to a height of 4,000 feet; it inhabits Burmah, the Malay Peninsula, the Indo-Chinese countries, the Philippine Islands, and the Malayan Archipelago as far eastward as Timor. This species varies considerably in the wild state. The wild G. bankiva agrees most closely with the black-breasted red game breed, in colouring and in all other respects, except in being smaller, and in the tail being carried more horizontally. But the manner in which the tail is carried is highly variable in many of our breeds; for, as Mr. Brent informs me, the tail slopes much in the malays, is erect in the games and some other breeds, and is more than erect in dorkings, bantams, &c. There is one other difference, namely, that in G. bankiva, according to Mr. Blyth, the neck-hackles, when first moulted, are replaced during two or three months, not by other hackles, as with our domestic poultry, but by short blackish feathers. It is a significant fact that the voice of both the male and female G. bankiva closely resembles, as Mr. Blyth and others have noted, the voice of both sexes of the common domestic fowl; but the last note of the crow of the wild bird is rather less prolonged."

Of the Turkeys we have the Ocellated Turkey (*Meleagris ocellata*), from Guatemala, the North American Turkey (*M. gallopavo*), and the Mexican Turkey (*M. mexicanus*), from Mexico, from which last species we believe with Mr. Gould that our domestic variety is a descendant.

Of the Guinea Fowl (*Numida*), all of which are natives of West Africa, we can only notice Numida ptilorhyncha, from Abyssinia, believed to be the bird from which our common guinea-fowl is derived.

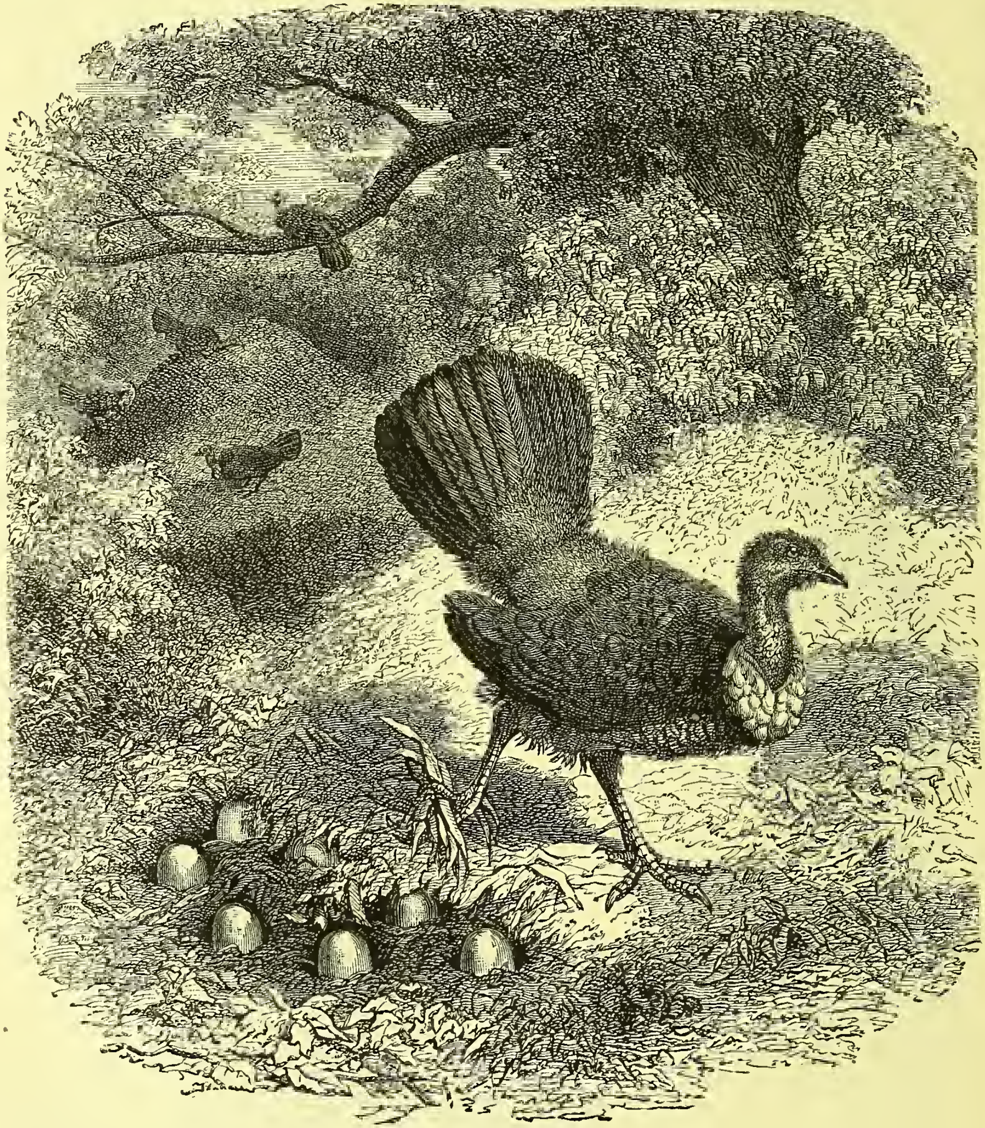
The family of the MOUND MAKERS and BRUSH TURKEYS, OR MEGAPODIDÆ, consist of a few very remarkable birds, only to be met with in Australia, New Guinea, and through the chain of islands in the South Pacific Ocean. Of each of the species much might be written; but we must content ourselves with Mr. Wallace's account of the Maleos, or the Red Mound Bird (*Megacephalon rubripes*):—

THE JUNGLE FOWL (*Gallus bankiva*).



THE WILD TURKEY (*Meleagris mexicanus*).

"Arrived at our destination, we built a hut and prepared for a stay of some days, I to shoot and skin 'maleos,' Mr. Goldmann and the major to hunt wild pigs, Babirusa and Sapi-utan. The place is situated in the large bay between the islands of Limbé and Banca, and consists of a steep beach, more than a mile in length, of deep, loose, and coarse black volcanic sand, or rather gravel, very fatiguing to walk over. It is bounded at each extremity by a small river with hilly ground beyond; while the forest behind the beach itself is tolerably level and its growth stunted. We have here probably an ancient lava stream from the Klabat volcano, which has flowed down a valley into the sea, and the decomposition of which has formed the loose black sand. In confirmation of this view, it may be mentioned that the beaches beyond the small rivers in both directions are of white sand. It is in this loose hot black sand that those singular birds the 'maleos' deposit their eggs. In the months of August and September, when there is little or no rain, they come down in pairs from the interior to this or to one or two other favourite spots, and scratch holes three or four feet deep, just above high water mark, where the female deposits a single large egg, which she covers over with about a foot of sand, and then returns to the forest. At the end of ten or twelve days, she comes again to the same spot to lay another egg; and each female bird is supposed to lay six or eight eggs during the season. The male assists the female in making the hole, coming down and returning with her. The appearance of the bird when walking on the beach is very handsome. The glossy-black and rosy-white of the plumage, the helmeted head, and elevated tail, like that of the common fowl, give a striking character, which their stately and somewhat sedate walk renders still more remarkable. There is hardly any difference between the sexes, except that the casque or bonnet at the back of the head, and the tubercles at the nostrils, are a little larger, and the beautiful rosy salmon colour a little deeper in the male bird; but the difference is so slight that it is not always possible to tell a male from a female without dissection. They run quickly, but when shot at or suddenly disturbed, take wing, with a heavy noisy flight, to some neighbouring tree, where they settle on a low branch; and they probably roost at night in a similar situation. Many birds lay in the same hole, for a dozen eggs are often found together; and these are so large that it is not possible for the body of the bird to contain more than one fully-developed egg at the same time. In all



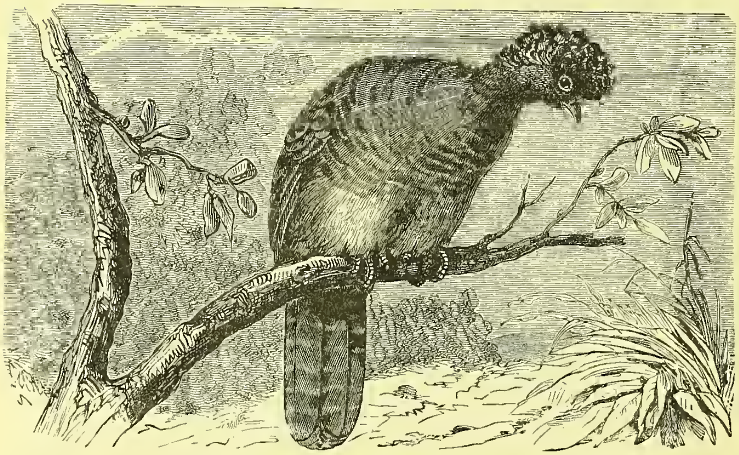
THE BRUSH TURKEY OF AUSTRALIA (*Telegalle*).

the female birds which I shot, none of the eggs besides the one large one exceeded the size of peas, and there were only eight or nine of these, which is probably the extreme number a bird can lay in one season. Every year the natives come for fifty miles round to obtain these eggs, which are esteemed a great delicacy, and when quite fresh are indeed delicious. They are richer than hens' eggs and of a finer flavour, and each one completely fills an ordinary tea-cup, and forms, with bread or rice, a very good meal. The colour of the shell is a pale brick red, or, very rarely, pure white. They are elongate and very slightly smaller at one end, from four to four-and-a-half inches long by two-and-a-quarter or two-and-a-half wide. After the eggs are deposited in the sand they are no further cared for by the mother. The young birds on breaking the shell work their way up through the sand and run off at once to the forest; and I was assured by Mr. Dnivenboden, of Ternate, that they can fly the very day they are hatched. He had taken some eggs on board his schooner which hatched during the night, and in the morning the little birds flew readily across the cabin. Considering the great distances the birds come to deposit the eggs in a proper situation (often ten or fifteen miles), it seems extraordinary that they should take no further care of them. It is, however, quite certain that they neither do nor can watch them. The eggs being deposited by a number of hens in succession in the same hole, would render it impossible for each to distinguish its own; and the food necessary for such large birds (consisting entirely of fallen fruits) can only be obtained by roaming over an extensive district, so that if the numbers of birds which come down to this single beach in the breeding season, amounting to many hundreds, were obliged to remain in the vicinity, many would perish of hunger. In the structure of the feet of this bird we may detect a cause for its departing from the habits of its nearest allies, the Megapodii and Talegalli, which heap up earth, leaves, stones, and sticks into a huge mound, in which they bury their eggs. The feet of the maleo are not nearly so large or strong in proportion as in these birds, while its claws are short and straight instead of being long and much curved. The toes are, however, strongly webbed at the base, forming a broad, powerful foot, which, with the rather long leg, is well adapted to scratch away the loose sand (which flies up in a perfect shower when the birds are at work), but which could not, without much labour, accumulate the heaps of miscellaneous rubbish which the large grasping feet of the Megapodius bring together with ease. We may also, I think, see in the peculiar organisation of the entire family of the Megapodidæ, or Brush Turkeys, a reason why they depart so widely from the usual habits of the class of birds. Each egg being so large as entirely to fill up the abdominal cavity, and with difficulty pass the walls of the pelvis, a considerable interval is required before the successive eggs can be matured (the natives say about thirteen days). Each bird lays six or eight eggs, or even more, each season, so that between the first and last there may be an interval of two or three months. Now, if these eggs were hatched in the ordinary way, either the parents must keep sitting continually for this long period, or if they only began to sit after the last egg was deposited, the first would be exposed to injury by the climate, or to destruction by the large lizards, snakes, or other animals which abound in the district; because such large birds must roam about a good deal in search of food. Here then we seem to have a case in which the habits of a bird may be directly traced to its exceptional organisation; for it will hardly be maintained that this abnormal structure and peculiar food were given to the Megapodidæ in order that they might not exhibit that parental affection or possess those domestic instincts so general in the class of birds, and which so much excite our admiration."

Of the CURASSOWS, OR CRACIDÆ, there are more than fifty species, all of them handsome birds, only to be met with in America, and there only in the great forests about the equator. They feed on fruits and insects, living on the ground, but roosting in the trees. They admit of being domesticated in warm countries, and with care have been extensively bred in Holland. The curassows belong to the genus Crax, and the South American guans to the genus Penelope, and many species of both genera are to be seen in European collections.

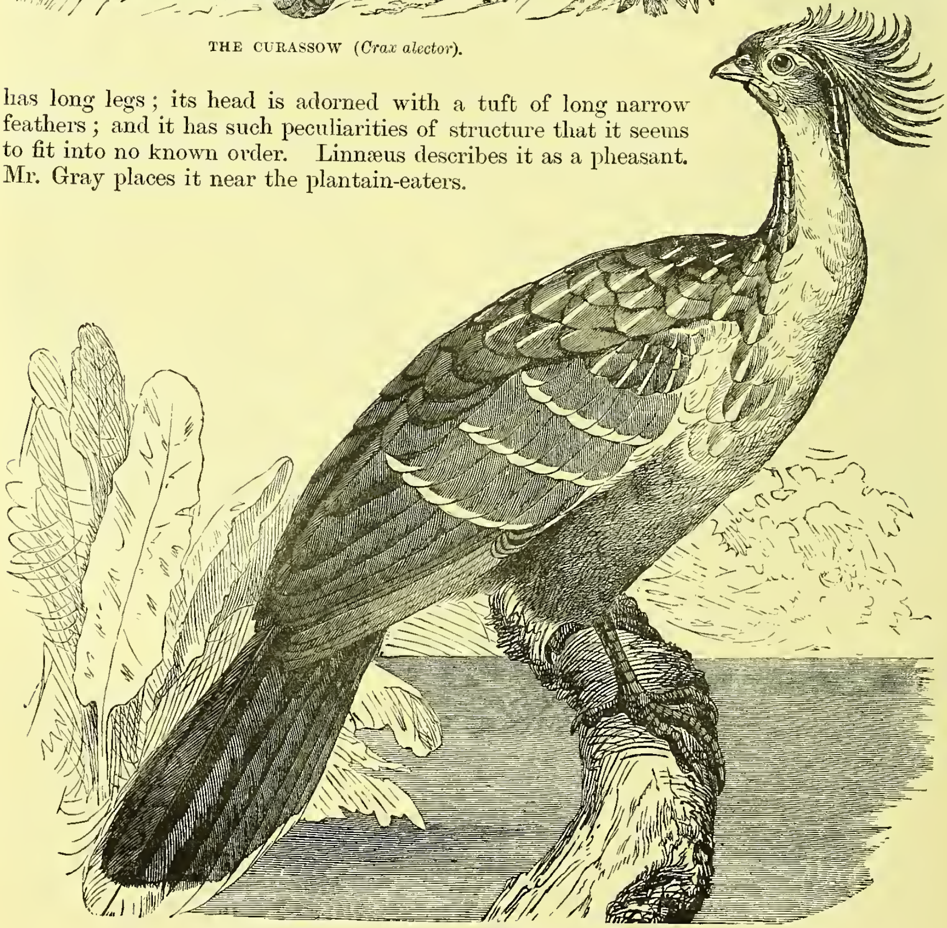
Next to the Curassows, Mr. Wallace places the family of the TINAMOUS, OR TINAMIDÆ, strange partridge-looking little birds, with either a very small tail or with none. Some think these birds are, despite the difference in size, near allies of the ostriches; and Dr. Sclater places them in an order (the Crypturi) next to the Struthiones. They are quiet-coloured ground birds, inhabiting the dense forests of tropical America. The Rufous Tinamous (*Rhynchotus rufescens*) breeds freely in the London Zoological Gardens.

ORDER VI.—OPISTHOCOMI.



THE CURASSOW (*Crax alector*).

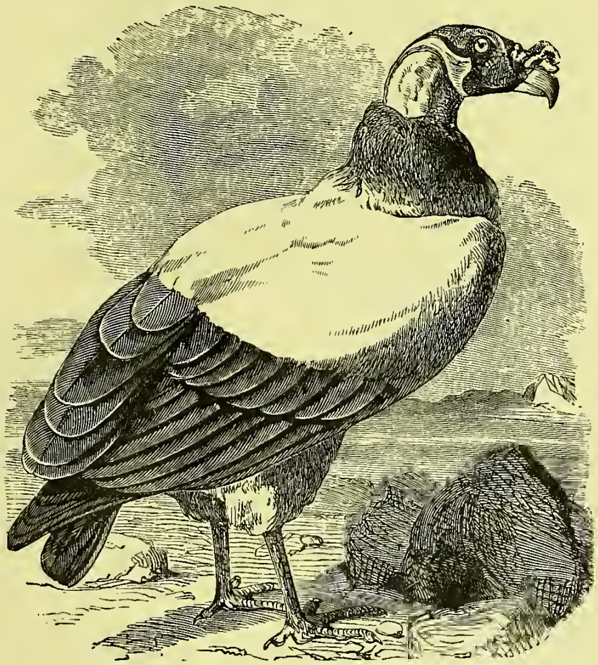
THE only bird belonging to this order is the Hoazin (*Opisthocomus cristatus*). It lives in large flocks on the banks of rivers in Brazil and Guiana. It is said to feed almost entirely on the leaves of an arborescent aroid, building its nest, which is formed of twigs and lined with soft material, in the lower parts of the same tree. At Pará it is called Cigana, or gipsy. It is nearly as large as a peacock; has long legs; its head is adorned with a tuft of long narrow feathers; and it has such peculiarities of structure that it seems to fit into no known order. Linnæus describes it as a pheasant. Mr. Gray places it near the plantain-eaters.



HOAZIN (*Opisthocomus cristatus*).

ORDER VII.—BIRDS OF PREY (*Accipitres*).

THIS order often receives the name of Raptores, or Robbers. It contains the well-known birds of prey. These are over 550 in number, and are distributed very evenly over the world, being, however, more abundant on continents than on islands. While almost exclusively meat-eaters, it is to be noted that some feed altogether on dead animal remains. The most distinctive characters of the birds of this order are furnished by their bills and feet. The bill is always rather short and strong, with the upper mandible strongly hooked and very sharp at the point. There is a cere at the base of the bill, in which the nostrils open. The feet are short and powerful, with four toes, armed with long, curved, sharp talons. With these they seize their prey, holding it while they feed on it. Their wings are always large in proportion to their bodies, and they are very powerful birds of flight. This order is often divided into two sub-orders — the Owls (*Nocturnæ*), and the Eagles and Vultures (*Diurnæ*); but the differences between these will be seen as we pass the various families in review.


THE KING VULTURE (*Vultur papa*).

The first family of these birds that must be noticed is that of the VULTURES OR VULTURIDÆ. In the more typical birds of this family the head, and frequently also the neck, is quite naked, being covered, instead of with feathers, with a sort of woolly down; their claws, though strong, are blunt; and the birds prey on dead flesh, seldom, if ever, attacking live animals. The true vultures of the Old World contrast with the condors of the New World; but in both hemispheres it is only the warm districts thereof in which these birds are found.

The Griffon Vulture (*Gyps fulvus*) is spread from the South of Europe throughout Turkey, Persia, and Africa, everywhere choosing its abode among lofty rocks and mountains. It appears, however, to be merely a summer visitor in Europe, passing, on the advance of the colder season, over into Africa, and hence, at certain periods, flocks of forty or fifty are to be seen crossing the Straits of Gibraltar, many having made the rock itself a temporary residence. It is, however, most abundant in the Pyrenees and the mountain districts of Spain, especially Granada; it is also found in the Alps and the Tyrol.

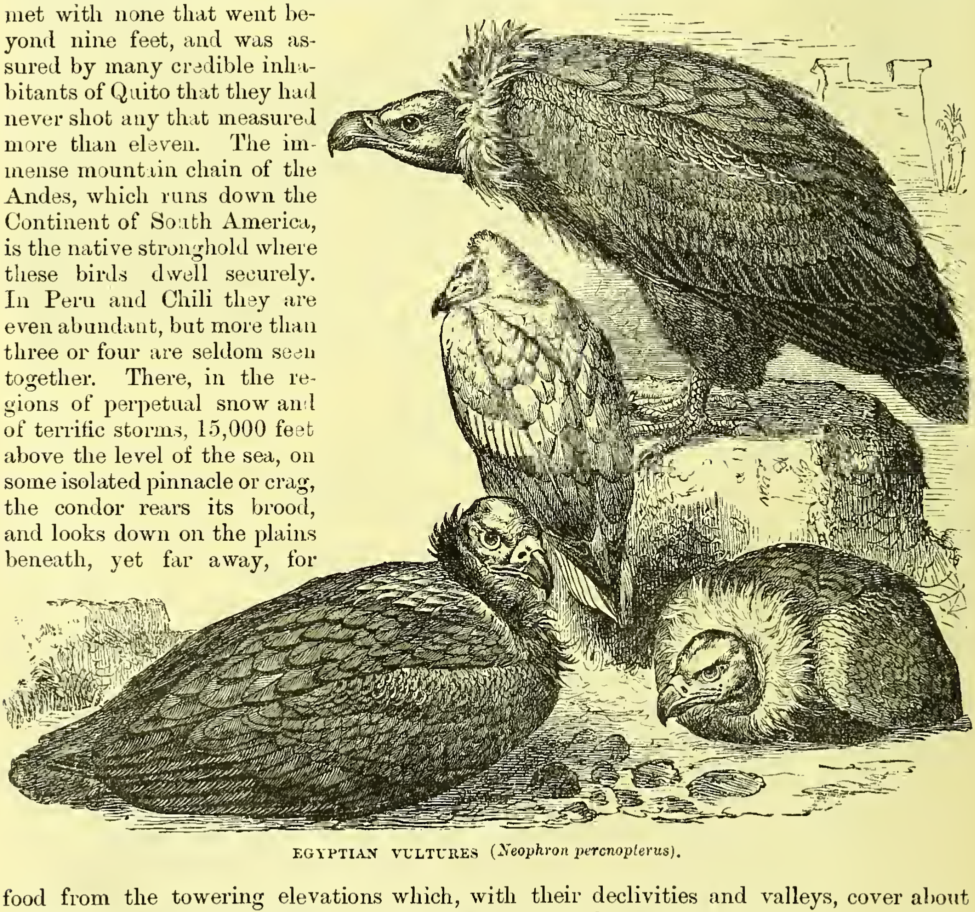
Like all other birds of its tribe, it feeds principally on carrion, to which it is frequently attracted in very considerable numbers. That eminent naturalist, Mr. Bennett, says:—"When it has once made a lodgment on its prey it rarely quits the banquet while a morsel of flesh remains, so that it is not uncommon to see it perched upon a putrefying corpse for several successive days. It never attempts to carry off a portion, even to satisfy its young, but feeds them by disgorging the half-digested morsel from its maw. Sometimes, but very rarely, it makes its prey of living victims, and even then of such only as are incapable of offering the smallest resistance; for in a contest for superiority it has not that advantage which is possessed by the falcon tribe of lacerating its enemy with its talons, and must, therefore, rely upon the force of its beak alone. It is only, however, when no other mode of satiating its appetite presents itself that it has recourse to the destruction of other animals for its subsistence."

The Egyptian Vulture (*Neophron percnopterus*) is well known to all visitors to Cairo, or travellers up the Nile. In size the Egyptian vulture is a very noble bird, its length being two feet five or six inches, and the expanse of its wings about five feet eight or nine inches. Long and ample as they are, they give the bird an amazing power of flight, and enable it to soar with great buoyancy.

A single specimen of this bird was killed on the shores of the British Channel, in October, 1825, and became the possession of the Rev. A. Mathew, of Kilve, in Somersetshire. When first discovered, it was feeding on the carcase of a dead sheep, and had so gorged itself with the carrion as to be unable, or unwilling, to fly to any great distance at the time; it was, therefore, approached without much difficulty, and shot. Another bird, apparently of this species, was seen at the same time on the wing at no great distance, but could never be approached within gun-shot. The one procured was in immature plumage, the dark feathers of the young state being beautifully mixed with others of a rich cream-yellow. The colour of the naked skin on the head was of a livid flesh-coloured red, that of the legs of a pale yellowish-grey.

The Cinereous Vulture (*Vultur cinereus*) is met with in some parts of Southern Europe. The only other species of this genus is the King Vulture (*V. papa*).

Of the American Vultures may be mentioned the Condor (*Sarcorhamphus gryphus*). This is the largest of the birds of prey. The extent of its wings is said sometimes to extend to fourteen feet, but this can be but rarely attained. Humboldt, in his travels, met with none that went beyond nine feet, and was assured by many credible inhabitants of Quito that they had never shot any that measured more than eleven. The immense mountain chain of the Andes, which runs down the Continent of South America, is the native stronghold where these birds dwell securely. In Peru and Chili they are even abundant, but more than three or four are seldom seen together. There, in the regions of perpetual snow and of terrific storms, 15,000 feet above the level of the sea, on some isolated pinnacle or crag, the condor rears its brood, and looks down on the plains beneath, yet far away, for food from the towering elevations which, with their declivities and valleys, cover about a sixth part of that continent. Here these birds find their home. They build no nest, but deposit their eggs on the naked rocks, without surrounding them even with straw

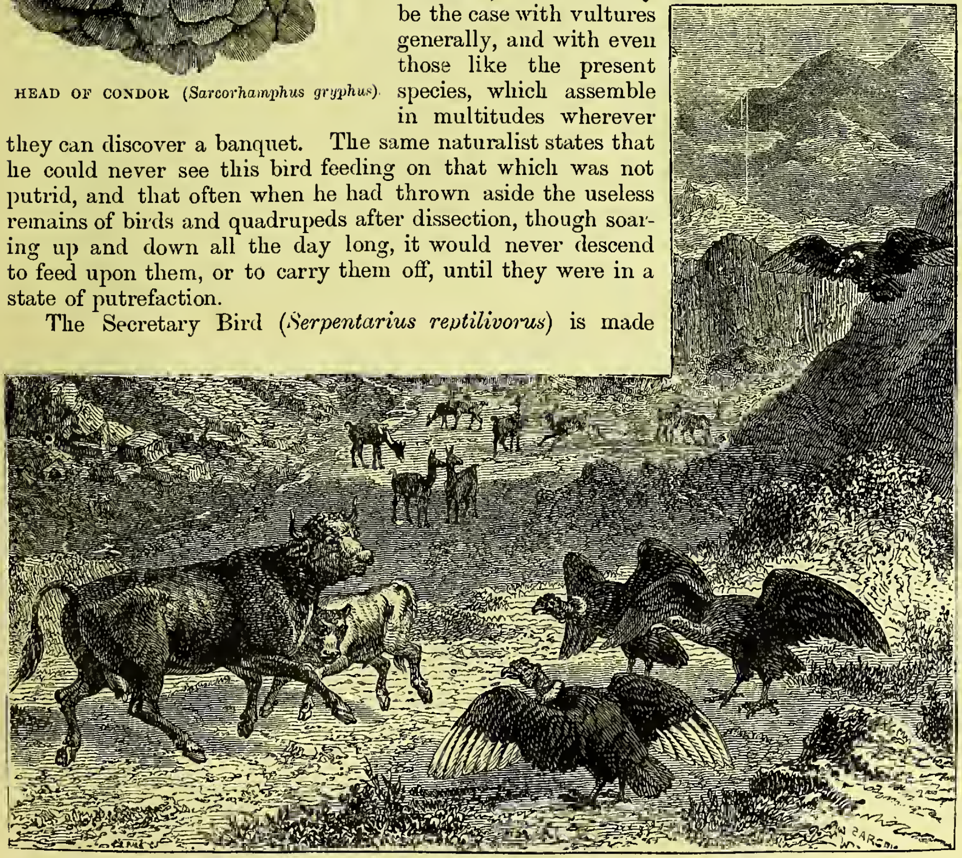


EGYPTIAN VULTURES (*Neophron percnopterus*).

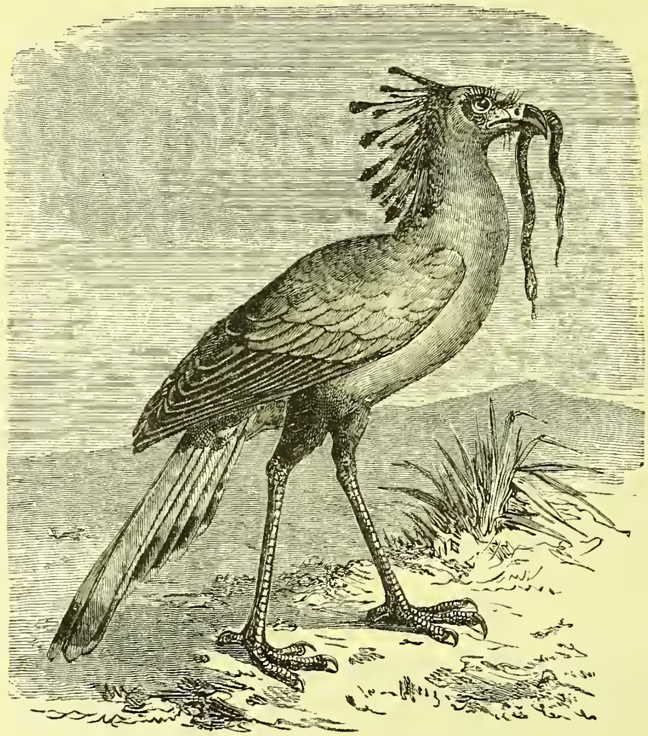
or leaves. The eggs are white, and from three to four inches in length. The female remains with her offspring for the space of an entire year. When driven by hunger, the condor descends into the plains, but leaves them as soon as its appetite is satiated, as if the increased weight of the atmosphere and the warmer temperature there soon became oppressive. It prefers resting on the ground, for which its comparatively straight talons are peculiarly fitted, to perching on trees. Like the rest of its family, it subsists on carrion, and so gorges itself as to become incapable of flight.

HEAD OF CONDOR (*Sarcorhamphus gryphus*).

The Turkey Vulture (*Cathartes aura*) is unfortunately so called, for, like the common eatable Turkey, it is peculiar to America. The general colour of the plumage is a glossy brownish-black, with green reflexions. In length it measures two feet four or five inches, and its stretch of wing is about six feet. Mr. Waterton states that, though the flocks collect for a common feast around a carcase, he does not consider the turkey vulture, properly speaking, to be gregarious, but each pair to pursue its separate interests; and this may be the case with vultures generally, and with even those like the present species, which assemble in multitudes wherever they can discover a banquet. The same naturalist states that he could never see this bird feeding on that which was not putrid, and that often when he had thrown aside the useless remains of birds and quadrupeds after dissection, though soaring up and down all the day long, it would never descend to feed upon them, or to carry them off, until they were in a state of putrefaction.


CONDORS (*Sarcorhamphus gryphus*).

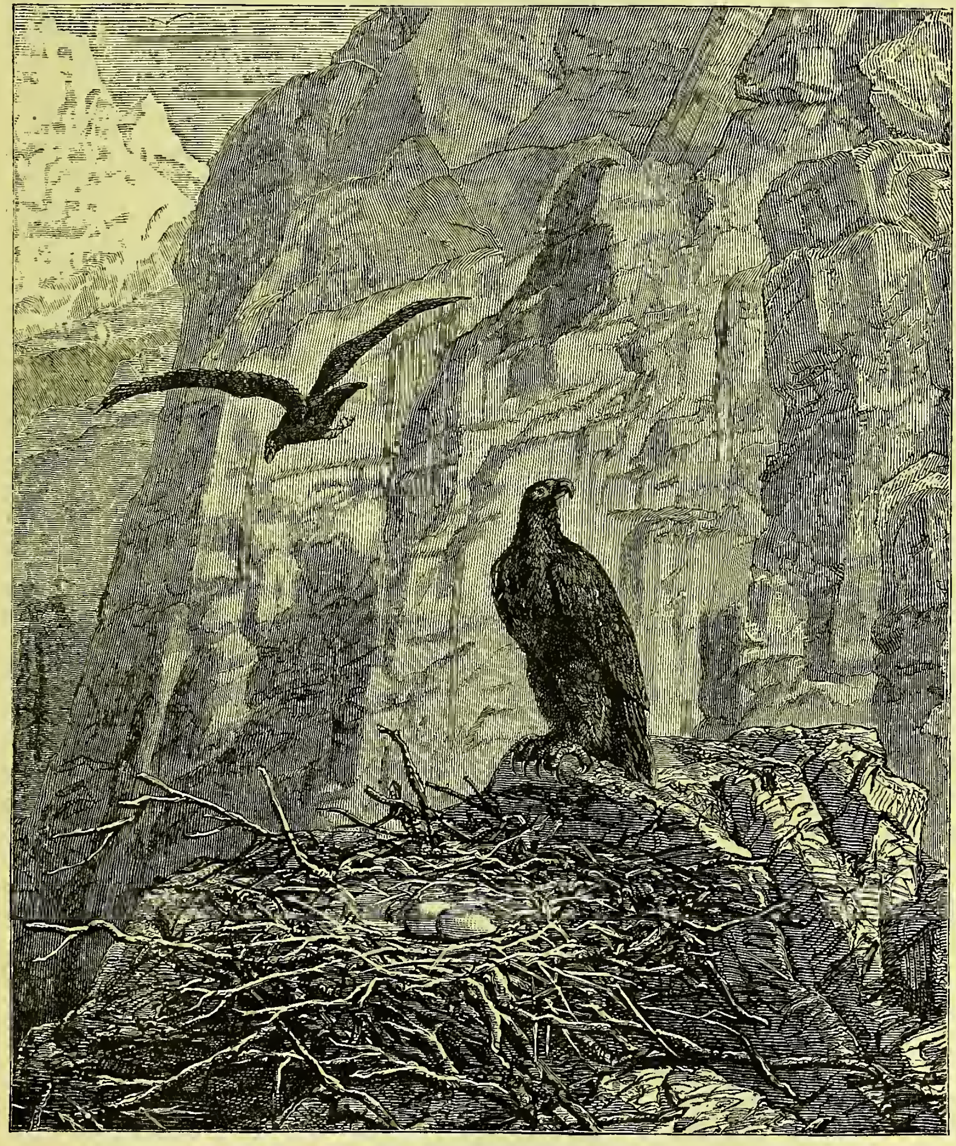
The Secretary Bird (*Serpentarius reptilivorus*) is made into a family by itself (SERPENTARIIDÆ) by Mr. Wallace. It may be said to resemble in some degree the eagle and the crane, having its head shaped like that of the former, and its body somewhat like that of the latter. Several dark-coloured feathers spring from the back of the head, and hang loosely behind like a pendent crest, and can be erected or depressed at pleasure. Le Vaillant says: "The Dutch gave it the name of secretary on account of the bunch of quills behind its head; for in Holland, clerks, when interrupted in their writing, stick their pen in their hair behind the right ear, and to this the tuft of the bird was thought to bear a resemblance." The Hottentots at the Cape of Good Hope called this bird serpent-eater, and in the destruction of these reptiles, which abound in its native country, it is very serviceable. On approaching them, it is always careful to carry the point of one of its wings forward to parry their venomous bites. Sometimes it spurns and treads upon its antagonist, or else, taking the serpent upon its pinions, throws it into the air. When it has at length wearied its adversary, or rendered it almost senseless, the bird kills and swallows the reptile at leisure without danger. The secretary bird makes a flat nest with twigs full three feet in diameter, and lined with wool and feathers. This is usually formed in some high tuft of trees, and is often so well concealed as not readily to be discovered. This bird is easily tamed, and when domesticated will eat any kind of food, either dressed or raw. Le Vaillant saw many in this state in the plantations of the Cape. He says they commonly lay two or three white eggs, nearly as large as those of a goose. The young remain a great while in the nest, because, from their legs being long and slender, they cannot easily support themselves. Even at the age of four months they may be seen to walk resting on the heel, which gives them an awkward appearance. It may generally be seen living in the Zoological Gardens in London.



THE SECRETARY BIRD (*Serpentarius reptilivorus*).

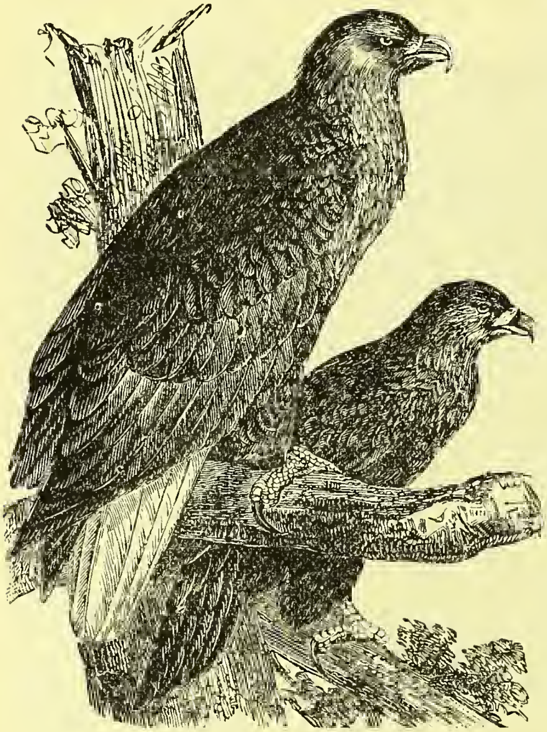
Of the EAGLES, OR AQUILIDÆ, the following are but a few out of the hundred species known. The Golden Eagle (*Aquila chrysaëtos*) is a native both of Europe and North America, being not very rare in parts of England, Scotland, and Ireland. Its eyry is placed on the face of some stupendous cliff situated inland; the nest is built on a projecting shelf, or on some stump of a tree that grows from a rock, generally in a situation perfectly inaccessible without some artificial means, and often out of the reach of shot, either from below or from the top of the precipice. It is composed of rude materials, as dead branches and roots of heather, in considerable quantity, entangled strongly together, but without any lining in the inside. The eggs are two in number, white, with pale brown or purplish blotches, most numerous and largest at the thicker end. During the season of incubation the quantity of food that is procured and brought to the nest is scarcely credible. It is composed of nearly all the wild inhabitants, or their young, of the district. Hares, lambs, and the young of deer, grouse, black game, ptarmigan, curlews, and plovers, all contribute to the feast.

Mr. Thompson states that an eagle was once seen in pursuit of a hare. The poor animal took refuge under every bush that it could find, which, as often as she did, the eagle approached the bush so near as apparently to beat the top of it with its wings, and thereby forced the hare to leave her place of refuge. In this way she was eventually driven to open ground, which did not long avail, as the eagle soon came up with her, and bore her away. Sir Humphry Davy tells us he once saw a very interesting sight above one of the crags of Ben Nevis, as he was going in the pursuit of black game. "Two parent eagles were teaching their offspring—two young birds—the manœuvres of flight. They began by rising from the top of the mountain in the eye of the sun. It was about midday, and bright for this climate. They at first made small circles, and the young birds imitated them. They paused on their wings, waiting till they had made their first flight,



THE EAGLE'S NEST.

and then took a second and larger gyration, always rising towards the sun, and enlarging their circle of flight, so as to make a gradually ascending spiral. The young ones still slowly followed, apparently flying better as they mounted; and they continued this sublime exercise, always rising, till they became mere points in the air, and the young ones were lost, and afterwards their parents, to our aching sight."


SEA EAGLES (*Haliëtus albicilla*).

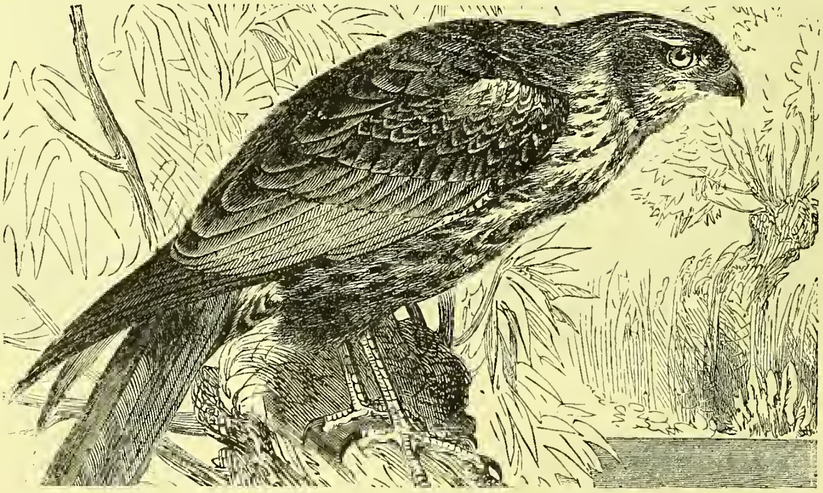
The Spotted Eagle (*Aquila nævia*), and the Imperial Eagle (*Aquila imperialis*), are also natives of Europe.

Of the Sea Eagles but one species, the Cinereous Sea Eagle (*Haliaëtus albicilla*), is found in Europe; it is not very rare in suitable localities in Great Britain and Ireland. The White-headed Sea Eagle (*Haliaëtus leucocephalus*) is a native of North America. It commonly attains its food by snatching from the fish-hawk its own hard-earned morsels.

The Common Kite (*Milvus ictinus*) is not very rare in Scotland, nor in some parts of England; it is a very rare visitant to Ireland, but is common throughout Europe.

The FALCONS, OR FALCONIDÆ, are absolutely cosmopolitan, including in this family the falcons, hawks, and buzzards. They are mostly solitary birds, not even as gregarious as the vultures.

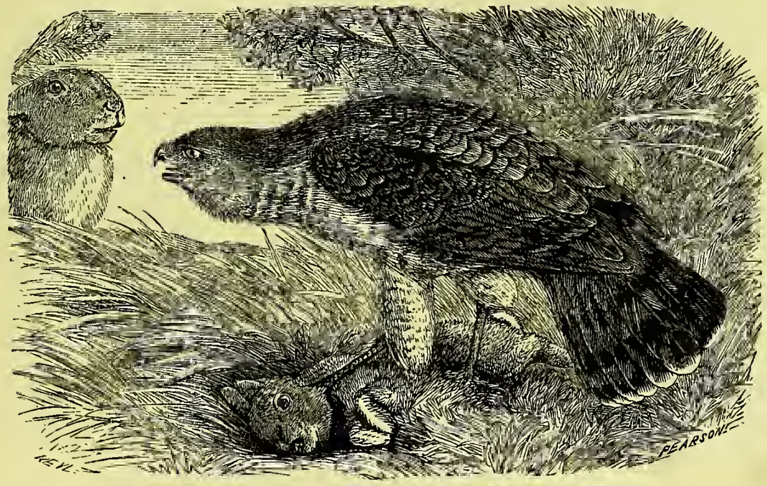
The Goshawk (*Astur palumbarius*) prefers for its dwelling-place the wooded dells of the mountains or the wild cliffs of the sea-shore, for there it can nestle undisturbed, and easily reach the spots which abound with birds and small quadrupeds, its usual prey. It flies, however, as civilisation advances, and hence is seldom seen in the lowlands of Scotland, and still more rarely in England. Where it abounds it is very destructive to mountain game, as it kills the old birds, and


THE MARSH HARRIER (*Circus æruginosus*).

the broods perish. Its eggs seldom exceed four. It formerly was much esteemed among falconers, and flown at hares, rabbits, &c.

The Common Sparrow Hawk (*Accipiter nisus*) is one of the most abundant of all the British birds of prey. It chooses extensive woods for its retreat, for there it can make excursions, and return at pleasure to its roosting-place or its nest. With a form adapted to pass rapidly among the trunks of trees and in thickets, and with its ample and rudder-like tail, it has a gliding flight in the open country, skimming, at a short distance from the ground, along the back of hedges or the skirts of some cover, while it passes easily and exactly with a bound any obstacle that appears in its way. With the same rapidity and ease the prey is seized, and the stoop to the ground and the capture are made so instantaneously as almost to elude the eye. The sparrow-hawk preys on small birds, its weight not allowing it to carry off a heavy quarry. Except in peculiar districts, a wood is chosen as its breeding-place. The nest is composed of sticks and twigs loosely put together on a straggling base, and there are from three to five eggs, of a bluish-white with large brown blotches.

The Hen Harrier (*Circus cyaneus.*) The breast, head, and all the upper part of the male are of a fine grey ; lighter on those parts which are white in the female, and also where the brown is lighter on the upper part of that bird. The remainder of the under part is white, with very faint markings ; yet, notwithstanding these differences, and those of the size and expression of the eyes, the birds exactly correspond in shape and air.



THE SPARROW-HAWK (*Accipiter nisus*).

The nest of this species of harrier consists of small sticks and coarse grass, and is placed on the ground. There are four or five eggs, which are either white or of a light blue. There is little or no difficulty in observing this bird in its home. Its flight is low, but smooth, graceful, and very swift.

The Marsh Harrier (*Circus æruginosus*). This, the largest British bird of the family, varies in length from twenty-one to twenty-three inches. It is found not only in England, Scotland, Ireland, and Wales, but also in many parts of Northern and Southern Europe, and has been observed in Smyrna, Trebizond, Egypt, and Tripoli, and even in the Himalayan Mountains. Its favourite haunts are heaths and wild marshy lands. When on the wing it skims the ground, and then drops suddenly on its prey. Moles, mice, rabbits, and various small quadrupeds, together with frogs and other reptiles, become, therefore, its easy prey. There is often a considerable variety in the tints of this species, and of the predominance or want of white on the head and throat.

Of the Buzzards, the Common Buzzard (*Buteo vulgaris*) is spread throughout Europe. There is great variety in the colouring of this bird, scarcely two specimens being similar in plumage. The differences chiefly consist in the depth of the shade of brown on the upper parts, and in a greater or less degree of marking below. The tail is barred, the beak of a lead colour, and the cere, iris, and feet yellow. It seldom takes the trouble to make a nest, but contents itself with one deserted by a crow or a magpie, which, if necessary, it enlarges.

Of the true Falcons, the Peregrine Falcon (*Falco peregrinus*) is one of the best known. In all suitable localities throughout Europe it will be met with. In olden times, more frequently than now, it was trained for hawking. The flight of the peregrine is amazingly rapid. Unless disappointed in its chase of prey, it is rarely seen sailing; and even then it rises with a broad, spiral circuit to a sufficient height to reconnoitre a certain space below. Its search is often made with a flight resembling that of a tame pigeon, until, catching sight of an object, it redoubles its flappings, and nears the timorous quarry at every turn and back-cutting which it attempts. Arriving within a few feet of it, the peregrine protrudes its powerful legs and talons to their full stretch. Its wings are, for a moment, almost closed; the next it seizes the prize, which, if too weighty to be instantly carried off, it forces obliquely towards the ground, sometimes a hundred yards from where it was captured, to kill or devour it on the spot.

The Kestrel (*Falco tinnunculus*) is even a common bird in the British Isles. The Merlin (*F. æsalon*) is one of the smallest of our falcons, but its form is perfect in symmetry. "It is," says Mr. Lloyd, "a very bold bird, and seems afraid of nothing. I one day winged one as he was passing over my head at a great height. The little fellow, small as he was, flung himself on his back when I went to pick him up, and gave battle most furiously, darting out his talons, which were as hard and sharp as needles, at everything that approached him. We took him home, however, and I put him into the walled garden, where he lived for more than a year. He very soon became quite tame, and came on being called to receive his food, which consisted of birds, mice, &c. So fearless was he, that he flew eagerly at the largest kind of sea-gull or crow that we gave him. When hungry, and no other food was at hand, he would attend the gardener when digging, and swallow the large earth-worms when turned up.

The FISHING HAWKS, OR PANDIONIDÆ, are almost universally distributed, although there are only three species. The best known of them is the Osprey (*Pandion haliaëtus*). It is a native of the Old and New Continents. In spring, it visits the shores of the larger rivers and lakes of Russia, Germany, and the middle province of Europe, and is occasionally seen in England, where, unfortunately, it is greatly persecuted.

Their first appearance is welcomed by the fishermen of the United States as the happy signal of the approach of vast shoals of herrings and shad. Such is the respect paid to the fish-hawk by this class of men, that a person who should attempt to shoot one of them would stand a fair chance of being insulted. Its appearance, indeed, procures it many a benediction from the fisherman, which Wilson, so eminent as an ornithologist, has happily commemorated in the following lines:—

THE FISHERMAN'S HYMN.

"The osprey sails above the sound,
The geese are gone, the gulls are flying;
The herring shoals swarm thick around,
The nets are launched, the boats are plying.
Yo ho, my hearts! let's seek the deep,
Raise high the song, and cheerily wish her,
Still as the bending net we sweep,
'God bless the fish-hawk and the fisher!'

"She brings us fish—she brings us spring,
Good times, fair weather, warmth, and plenty,
Fine stores of shad, trout, herring, ling,
Sheepshead, and drum, and old wives' dainty.
Yo ho, my hearts! let's seek the deep,
Raise high the song, and cheerily wish her,
Still as the bending net we sweep,
'God bless the fish-hawk and the fisher!'

"She rears her young on yonder tree,
She leaves her faithful mate to mind 'em;
Like us, for fish, she sails to sea,
And, plunging, shows us where to find 'em.
Yo ho, my hearts! let's seek the deep,
Raise high the song, and cheerily wish her,
Still as the bending net we sweep,
'God bless the fish-hawk and the fisher!'"

THE OSPREY (*Pandion haliaëtus*)

The other species are P. carolinensis, met with in America, and P. leucocephalus, ranging from India through the Malay Archipelago to the Sandwich Islands.

The Owls, or Strigidæ, form an exceedingly well-marked family of nocturnal birds of prey. Not so very closely related as it was at one time thought to the hawks, noiseless in flight, they prey chiefly on small vertebrate animals, though many of them are also insectivorous, eating the large night-flying moths and beetles, which they either swallow entire, seizing them with their feet, or tear to pieces before devouring. They disgorge all the more indigestible portions in the form of pellets. During daylight they retire to holes in trees or in rocks, or to old buildings. Their note varies, being in the Barn Owl a screech, while it is a most dolorous cry, resembling the syllable hoo-hoo-hoo in the Hooting Owls. The Great American Horned Owl has a wonderful variety of cries; the commonest Wilson describes as waugh-o-waugh. The Ceylon Ketupa has a hollow, laugh-like call, haw-haw-haw-ho, and some species give a more or less prolonged whistle.

THE BARN OWL (*Strix flammea*).

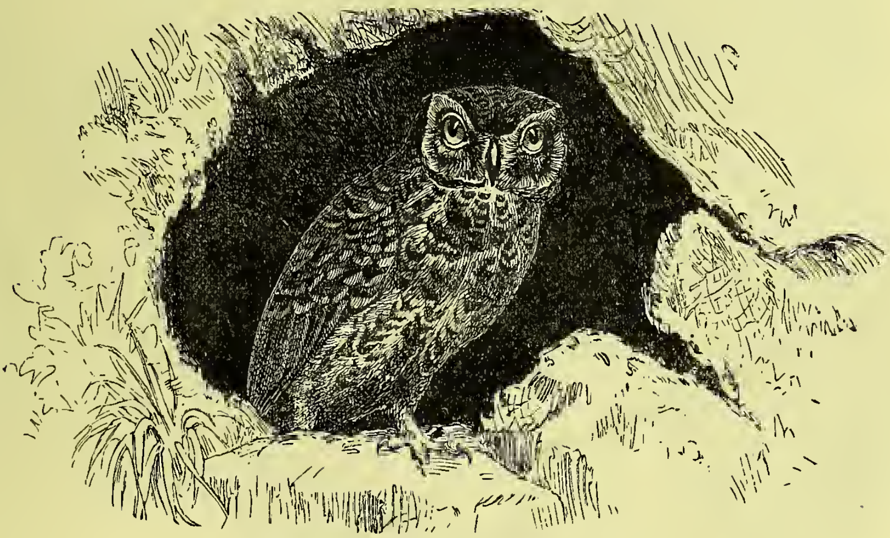
The Common Barn Owl (*Strix flammea*) is generally considered to be the typical example of the owl tribe, as it exhibits in great perfection the different characteristics of the owls—namely, the thick coat of downy plumage, the peculiar disc round the eye, the large eyeballs, and the heavily-feathered legs and toes. The feathers are so thickly set upon this bird that it appears to be of much greater dimensions than is really the case. When standing on its feet, or while flying over the fields like a huge bunch of thistle-down blown about by the night breeze, the barn owl appears to be rather a large bird; but when the creature is lying on the bird-stuffer's table, after its skin and feathers have been removed, the transformation is really astonishing.

The Long-eared Owl (*Otus vulgaris*) is also common in England, and extends to Asia, Africa, and America.

THE EAGLE OWL (*Bubo maximus*).

The Great Eagle Owl (*Bubo maximus*) is a bird of rare occurrence in England and France, but it dwells among the deep recesses of vast forests in Norway, Sweden, Russia, or Hungary, or in the clefts of rocks or the desolate ruins of ancient towers. Temminck says it is found at the Cape of Good Hope. Willoughby observes that about Bologna, and elsewhere in Italy, it is frequent. Bonaparte notes it as rare in the neighbourhood of Rome, and says that it is only seen in mountainous situations. It is stated to extend eastward as far as Kamstchatka.

The Java Fish Owl (*Ketupa javanensis*) is of interest, as being a fish-eating species. The Snowy Owl (*Surnia funerea*) is a native of the Arctic Circle and the forlorn mountains of Greenland, which are covered with eternal ice and snow. It is also found in Lapland, Norway, and the country near Hudson's Bay, during the whole year, and is said to be common in Siberia, and numerous in Kamstchatka. It is often seen in Canada and the northern districts of the United States, and sometimes visits even the borders of Florida, as well as Scotland and Ireland. The bill is almost hidden in the mass of feathers that cover the face. The legs are clothed with such long, thick, hair-like plumage as to appear nearly as large as those of a middle-sized dog, the claws only being visible. These are large, hooked, and extremely sharp. The entire plumage below the surface is of the most exquisitely soft, warm, and elastic kind, and so closely matted together as to make it a difficult matter to penetrate to the skin.



THE NAKED-FOOTED OWL (*Athene noctua*).

We have only left ourselves space to allude by name to the Burrowing Owl (*Pholeoptynx cunicularia*), which we have incidentally mentioned when writing about the Prairie Dogs of America ; to the Naked-footed Owl of Europe (*Athene noctua*); and to the Wood Owl of Europe (*Syrnium aluco*).

ORDER VIII.—WADERS (*Grallæ*).

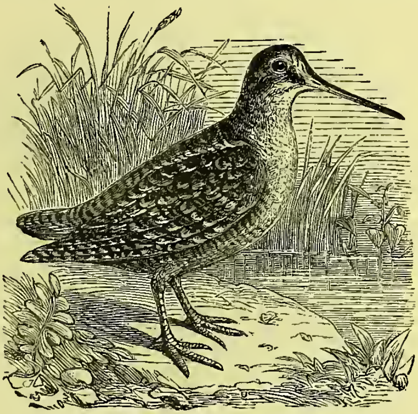
THIS order includes all the wading birds. Their feet are usually of great length, and their toes, except in the flamingoes, are not united by a membranous web, though each toe is often webbed. The toes are usually four in number, three in front and one behind. The hind toes are sometimes very short, but in some of the waders are very long. Although in most of the species the legs are well adapted for wading, yet in several of the rails the legs are short and stout, and formed for running. Most of the birds belonging to the order are found near marshy places; but some few are fond of dry, even upland situations. In nearly all the wings are well developed, and some of them are powerful flyers. Their plumage is soft; and most of them are insect feeders.

MOOR HEN (*Gallinula chloropus*).

The first family, that of the WATER HENS, OR RALLIDÆ, consists of a pretty numerous assemblage of waders, and contains over 150 species, very widely distributed. Some of them are found in remote islands, and have lost all power of flight. Many swim with ease, and can dive to a great depth.

The Common Water Rail (*Rallus aquaticus*) remains in this country all the year, being found in damp meadows and marshes, feeding on water insects, slugs, and vegetable matter.

The Spotted Crake (*Porzana maruetta*) is another native species. But, perhaps, the best known is the Land Rail, or Corn Crake (*Crex pratensis*). In the rich meadows of most parts of Britain, the very peculiar cry of this bird may be heard resounding on every side during the whole or greater part of May. Now the land rail seems close at hand, as if the bird were not a yard off; now it is far distant, while other voices in different parts of the meadow keep up the reiterated note, crake, crake, crake, from which the English and the Latin names are derived.


THE WOODCOCK (*Scolopax rusticola*).

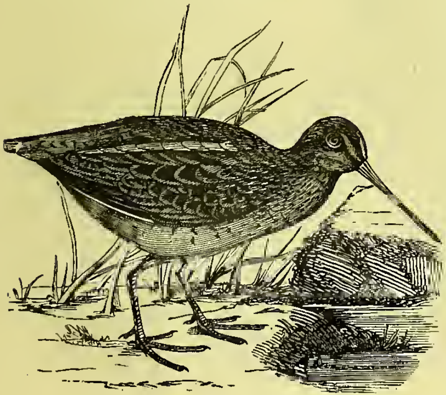
Of the Coots, one species (*Fulica atra*) is well known in England. The toes of the coots are bordered with long membranous lobes, like the grebes.

Of the Water Hens, the Common Moor Hen (*Gallinula chloropus*) is dispersed over Europe generally. It inhabits ponds, slow-moving and deep waters, canals, &c., where the borders are covered with luxuriant herbage, osier-beds, or reeds.

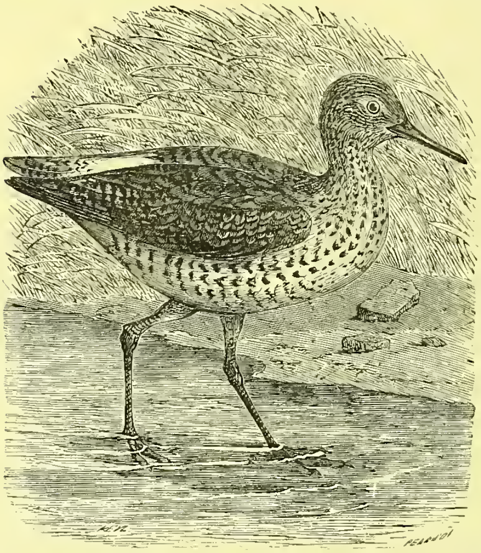
Gallinula mesiotis is remarkable as being found only on the Island of Tristan d'Acunha.

Mantell's Notornis (*Notornis mantelli*) is only found on Lord Howe's Island and in New Zealand. It has lost the power of flight, but it runs with great speed. It probably has the power of swimming. The head, neck, breast, and upper part of the tail are of a deep green olive, tipped with copper-green; a beautiful blue stripe separates the purple-blue of the neck from the green of the back; the lower part of the body and the thighs are of a dull bluish-black; the wings are of a beautiful deep blue; the long feathers are tipped with green, forming a crescent when the wings are extended. The tail is deep green; its under part white. The beak, talons, and iris are of a brilliant red. Its height is about two feet.

The SNIPES, SANDPIPERS, AND CURLEWS, OR SCOLOPACIDÆ, form a natural family of widely-spread birds. The Phalaropes are the most coot-like of the family. The Grey Phalarope (*Phalaropus lobatus*) is an occasional autumnal visitor to Great Britain and Ireland.


THE SNIPE (*Scolopax gallinago*).

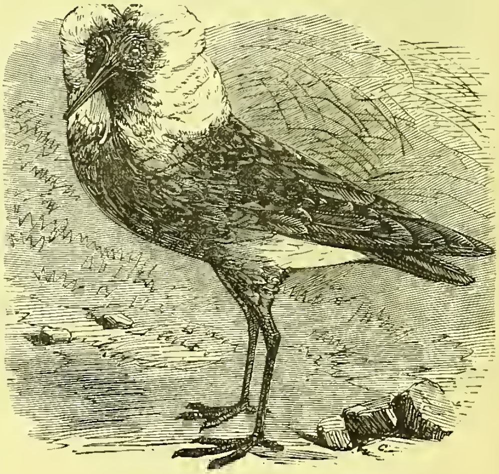
The Woodcock (*Scolopax rusticola*) is a native of the northern provinces of Continental Europe, but instances are known of its remaining in England and Ireland to breed, thus passing the summer with us. It is, however, strictly speaking, a winter visitor to our shores. "The first autumnal flight of the woodcock," says Selby, "on its retreat from the northern countries of Europe, where it breeds and passes the summer, generally takes place towards the end of September or the beginning of October; but as this consists of birds whose flight is directed to more southern latitudes than our islands, a few stragglers only remain, and the flight, after resting for a day or two, proceeds on its course to Portugal, and so onwards to the furthest limit of its equatorial movement. The direction taken by such great and successive columns of these birds, under migration from the north to the southern parts of Europe and Northern Africa, being in a great measure intersected by the south-western coasts of England and Ireland, accounts for the abundance of them in Devonshire and Cornwall and the countries thus situated, and the still greater numbers found in the southern and western districts of Ireland, compared with the other parts of the kingdom."


THE RED SHANK (*Totanus calidris*).

The Snipe (*S. gallinago*). This bird, though a winter visitant, remains in numbers constantly in Britain, merely changing its abode according to the state of the weather, or the scarcity and abundance of food in different localities. Its nest is found in a tuft of rushes or heath, in the midst of the moorland or marsh. Mr. Selby says:—"In addition to our native snipes, great flights come annually from Norway and other northern parts of Europe; and in Northumberland they arrive in the greatest numbers in the beginning of November. They seldom remain long in one situation, moving from place to place, under the regulation of various causes; so that the sportsman who has enjoyed excellent snipe-shooting one day may find the same spots entirely deserted on the following. Towards the end of March or the beginning of April snipes, having nearly perfected their summer or nuptial plumage, select appropriate places for nidification, and the male bird commences his calls of invitation for a mate. These are always uttered upon the wing, and consist of a piping or clicking noise, often repeated, and accompanied at intervals by a humming or bleating noise, not unlike that of a goat, apparently produced by a peculiar action of the wings, as the bird, whenever the sound is emitted, is observed to descend with great velocity, and with a trembling motion of the pinions. At this season it soars to an immense height, remaining long upon the wing; and its notes may frequently be heard when the bird itself is far beyond the reach of sight. These flights are performed at intervals during the day, but more commonly towards the evening, and are continued during the whole time that the female is engaged in incubation."

The Red Shank (*Totanus calidris*) is not uncommon around our coasts.

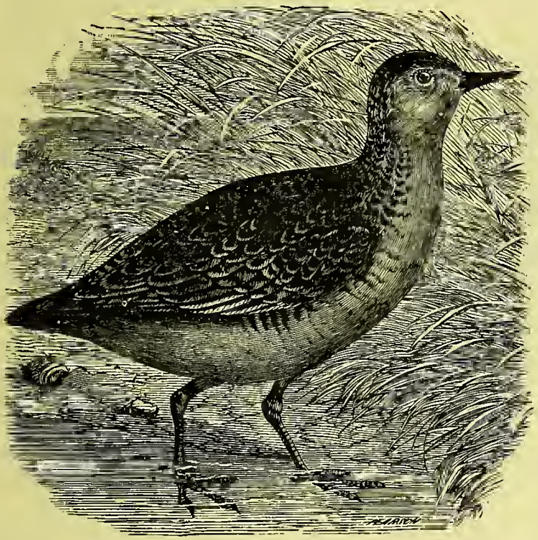
The Ruff (*Machetes pugnax*) is so called in consequence of the ruff-like ornamental plumes on the neck of the male bird during the breeding season; the female, to whose attire no such addition is made, is termed the Reeve.


THE RUFF (*Machetes pugnax*).

The actions of these birds in fighting are very similar to those of the game-cock: the head is lowered, and the beak held in a horizontal direction, the ruff, and indeed every feather, more or less distented, the head sweeping the ground as a shield to defend the more tender parts, the ear feathers erected, and the tail partly spread; upon the whole, it assumes a most ferocious aspect. When either bird can obtain a firm hold with the bill, a leap succeeds, accompanied by a stroke of the wing, but they rarely seriously injure each other.

The Curlew (*Numenius arquatus*) is common along the coasts of the Old World, where its wild whistling cry is too well known to need description.

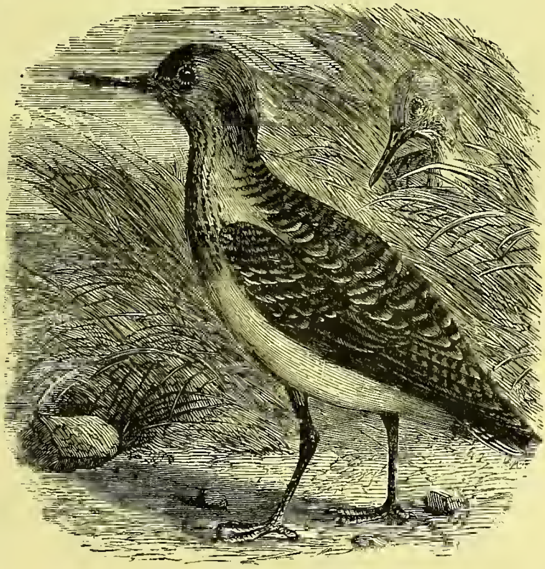
The Avocet (*Recurvirostra avocetta*) is so called from having a very remarkable bill, curved in an upward direction. "This bird," says Mr. Yarrell, "is apparently more rare than formerly. Sir Thomas Brown says they were not uncommon in his time in the marshy lands of Norfolk; and some years ago I was told that more than twenty specimens were received at Leadenhall Market for sale within one month; but now scarcely an example appears once in a year—the last I heard of was in the spring of 1837."



THE KNOT (*Tringa canutus*).

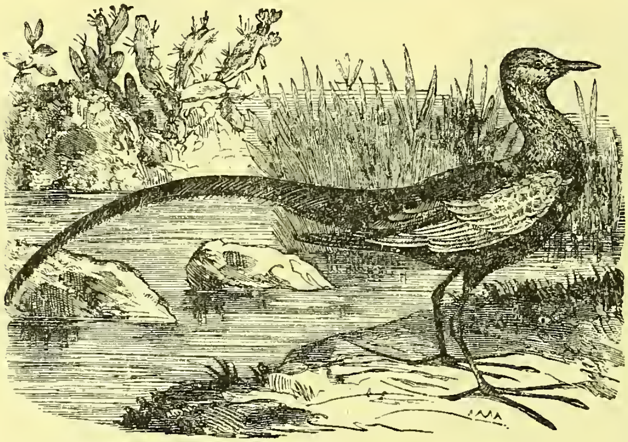
We can only mention the following by name:—The Knot (*Tringa canutus*); The Dunlin (*T. cinclus*); The Sandpiper (*Tringoides hypoleucos*).

The family of the SHEATH-BILLS, OR CHIONIDÆ, contain but a single genus, and the two species are confined to Kerguelen's Land and the Crozets (*Chionis minor*), and to Antarctic America (*Chionis alba*); they are pretty white pigeon-like birds, with strong bills, which have a horny sheath at their base. Professor Cunningham, in his "Natural History of the Straits of Magellan," thus writes of the Yellow-billed Sheath-bill (*C. alba*):—"At about 3 p.m. on the 17th, a fine but very cold day Cape Virgins was sighted, much to our satisfaction, as there was an almost unanimous feeling of pleasure in the return to the field of our labours. The first living creatures seen outside the Strait were a cormorant and a penguin (*Spheniscus magellanicus*), and as we entered it, and approached Dungeness Spit, a most remarkable spectacle was furnished by a herd of between fifty and sixty sea-lions assembled on the shelving beach. It was curious to watch the huge unwieldy monsters rearing up their heads, and plunging down the shelving beach to the water, where they splashed about. A great flock of cormorants was also seated erect on the Spit; and soon after some one pointed out several so-called 'pigeons' flying about not far from us. These—which it was certainly very pardonable to mistake for pigeons, from their resemblance in flight and colouring—I immediately recognised as the Sheath-bill (*Chionis alba*), which we did not meet with in the previous season. This interesting bird forms one of two species of a genus, regarding the true position of which in the ornithological system considerable difference of opinion has been entertained by ornithologists—some placing it among the Gallinæ, while others, and I think with more reason, are disposed to regard it as



THE SANDPIPER (*Tringoides hypoleucos*).

belonging to the Grallæ, and allied to Hæmatopus. The above species, which derives its English name from the peculiar form of the upper mandible, was first described by Forster, and is mentioned in Cook's Voyage towards the South Pole in 1772-75, as having been found at Staten Land. Cook remarks very truly that the bird 'is about the size of a pigeon, and as white as milk,' and mentions that it has a very disagreeable smell, a circumstance also commented on by Mr. Darwin, but which I did not notice in the two specimens which I had an opportunity of examining. The legs are long, of a blackish-grey colour, and bear a considerable resemblance to those of an oyster-catcher (*Hæmatopus*). They feed on molluscs and other marine animals, and are often to be seen far out at sea to the south of Cape Horn. In the Strait of Magellan, however, they do not appear to be common, as I only noticed them on one or two occasions."

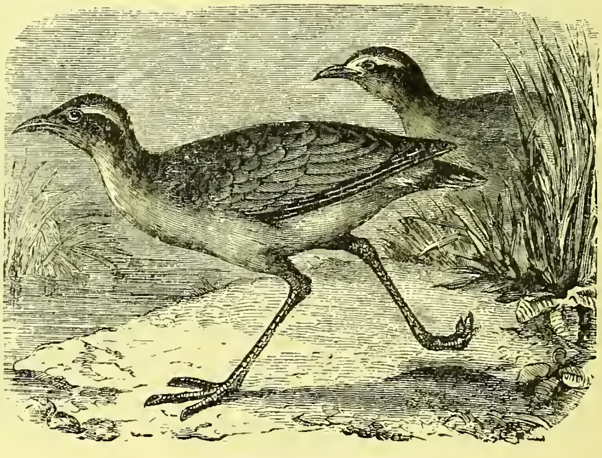


THE WATER PHEASANT (*Hydrophasianus sinensis*).

The QUAIL SNIPES, OR THINOCORIDÆ, are little birds, only to be met with in the temperate districts of South America. Of one species (*Thinocorus rumicivorus*), Mr. Darwin remarks, "that found in the whole of Southern South America, wherever there are sterile plains, or upon open dry pasture land, this bird seems to nearly equally partake of the characters, different as they are, of the quail and of the snipe." The species of the only other genus, Attagis, chiefly frequent the zone of Alpine plants.

The JACANAS, OR PARRIDÆ, are birds with wonderfully long toes. They are only found in the tropical regions of Asia, Africa, and America, and in their general habits they closely resemble the moor hens. They trip over the floating leaves of aquatic plants with singular ease and grace, searching for the insects which constitute their food. The Common Jacana (*Parra jacana*) inhabits Brazil; and the Water Pheasant (*Hydrophasianus sinensis*) is to be met with in China; and Dr. Leith Adams, in recording it from Cashmere, says its flight is irregular, and, like the magpies, it builds its nest on the broad leaves of the lotus. Its call note is loud and harsh.

The PRATINCOLES AND COURSERS, OR GLAREOLIDÆ, are distributed throughout the Old World, reaching to Australia. Linnæus placed the pratincoles among the swallows, but without knowing at the time the Collared Pratincole (*Glareola pratincola*), which is not uncommon in mid-Europe, and has even been captured in England. The Cream-coloured Courser (*Cursorius europæus*) also occurs occasionally in England, and is common in South Europe and Africa.



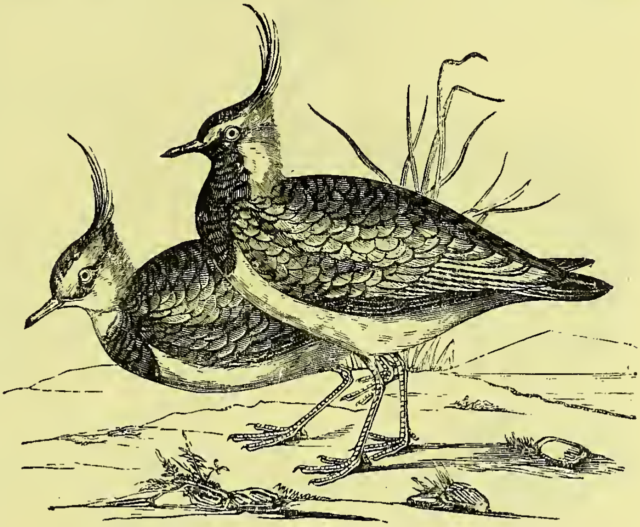
THE COURSER (*Cursorius europæus*).

The PLOVERS, OR CHARADRIDÆ, and their allies, form a large family, to be met with in every quarter of the globe. Many of the species are among our most familiar birds, of which much might be written. The Thicknee (*Œdicnemus crepitans*) is a native of Asia, Africa, and the South of Europe, and visits Great Britain in considerable numbers every summer.

The Common Lapwing (*Vanellus cristatus*), often called the Peewit, occurs in immense flocks all over the country. The Grey Plover (*Squatarola helvetica*), and the Golden Plover (*Charadrius pluvialis*), are well-known birds. The latter, spread over the whole of Europe, is by no means uncommon in our islands, frequenting heaths and swampy moors, but more especially the barren hilly districts of Scotland, and the adjacent countries, where it breeds.

The Common Oyster-catcher (*Hæmatopus ostralegus*) is a handsome bird, sometimes called Sea Pie.

The Turnstone (*Strepsilas interpres*) is common on European shores, and annually pays the shores of Great Britain and Ireland a visit. It receives its name from its peculiar habit of turning over stones in search of its insect food.

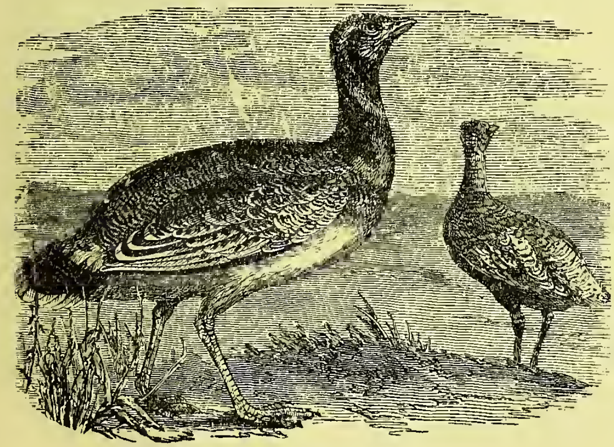


THE LAPWING (*Vanellus cristatus*).

The Bustards, or Otididæ, are Old World birds. Both the species of the genus Otis were at one time to be met with in England; but the Great Bustard (*Otis tarda*) is now extinct on the Wiltshire Downs, and the Little Bustard (*O. tetrax*) is only an occasional straggler from the Mediterranean shores. Nearly all the species of Eupodotis are African.

The Cranes, or Gruidæ, form a small family, containing less than twenty species. These all are handsome birds, with long slender legs. The tertiary wing-coverts are often very long and filamentous, forming beautiful plumes, hanging down on each side of the tail. They chiefly inhabit warm countries, but perform long migrations.

The Common Crane (*Grus cinerea*) is known to visit Siberia in the spring, breeding there, and then returning to Africa and Southern Asia in the winter. At stated times flocks of these birds may be seen in France and Germany, passing northwards and southwards, according to the season, in marshalled order, high in the air, their sonorous voices distinctly heard even from their elevated course. Occasionally they descend, attracted by newly-sown fields or the prospect of finding food in marshes, on the borders of rivers, or even the shores of the sea, but generally they continue their flight unchecked towards their destined resting-places. Willoughby says:—"The flesh is very savoury and well tasted, not to say delicate;" and, indeed, it seems to have been very highly prized in former days.



THE LITTLE BUSTARD (*Otis tetrax*).

The Numidian Crane (*Anthropoides virgo*) is an elegant species, to which the name of Demoiselle was given by the French Academicians. It is remarkable for its graceful symmetry of form, the tasteful disposition of its plumage, and the agreeable contrast of its lighter and darker shades of colour. It measures, when fully grown and in an upright position, about three feet six inches to the top of the head; and its length, from the point of the bill to the tip of the tail, is about three feet.

THE COMMON CRANE (*Grus cinerea*).

The Balearic Crane (*Balearica pavonina*) is a bird considerably larger than the demoiselle crane, and though less graceful in form and attitude, it is far more elegant in the varied colours of its plumage. It measures, when fully grown, about four feet in total height. The cheeks and temples are entirely naked, and are covered with a bright rosy red, which sometimes overspreads the whole of the naked surface, and sometimes is confined to a portion of it. A similar naked space beneath the upper part of the throat is gradually developed, and terminates in a fold of skin resembling the wattle of a turkey. A close tuft of short, smooth, even, velvety, deep-black feathers covers the fore-part of the head, and behind them rises a very remarkable crest, each filament of which is twisted spirally on itself, is fringed along its edges with a series of black-pointed hairs, and terminates in a blackish pencil.

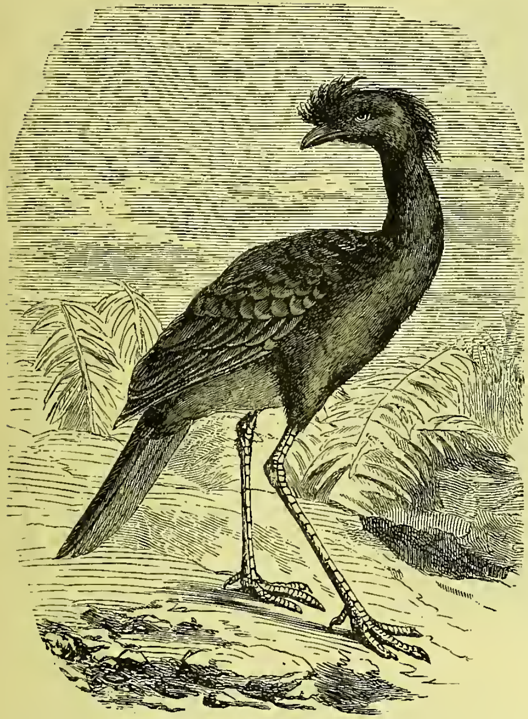
The family CARIAMIDÆ is made for the species of Cariamas. The Cariama (*C. cristata*), of Brazil, is a bird about the size of a heron, which runs with immense rapidity, and is generally hunted on horseback. Some would rank it as an aberrant bird of prey. It feeds on insects and reptiles. The second species (*C. burmeisteri*) is from the La Plata district, and is beautifully figured in the "Zoological Society's Proceedings" for 1870.

The GUARAUNAS, OR ARAMIDÆ, form an equally small family, usually classed with the rails, but having a heron-like form. The two species are natives of tropical America. The Aramus giganteus is met with in the more northern portion of this district, and the A. scolopaceus in the more southern.

The TRUMPETERS, OR PSOPHIDÆ, are beautiful birds, with a most remarkably limited geographical distribution, being found only in the Great Amazon Valley. Mr. Wallace thinks the range of the species, though they are capable of flight, is defined by the areas of the rivers of this district. They show very great affinities to the scraping birds, are easily tamed, and associate freely with domestic poultry. They will even follow their masters about like a dog. They emit a deep, rough, trumpet-like sound, from whence their name. The Common Trumpeter (*Psophia crepitans*), called Agami by the natives of South America, is about the size of a large fowl, and may generally be seen in the London Zoological Gardens, Regent's Park.

THE BALEARIC CRANE (*Balearica pavonina*).

The Sun Bitterns, or Eurypygidæ, are placed here. They are heron-like birds, with gaudy plumage, found in Central tropical America. Of the two species, one—the Sun Bittern (*Eurypyga helias*)—breeds very freely in the London Zoological Gardens. Very closely related to this bird is the Kagu (*Rhinochetus jubatus*), from New Caledonia. A beautiful figure of this very strange bird may be seen in the "Proceedings of the London Zoological Society" for 1862.


THE CARIAMA (*Cariama cristata*).

The well-known Herons and Bitterns (Ardeidæ) form a large cosmopolitan family. Of the upwards of eighty species, we can here only mention the Common Heron (*Ardea cinerea*). It is an indolent, solitary bird, everywhere abundant in this country. It commonly captures its prey by standing in the water, and pouncing upon it as it swims within its reach. They build and roost in trees.

The Purple Heron (*A. purpurea*) is not uncommon in Europe, and occasionally visits England.

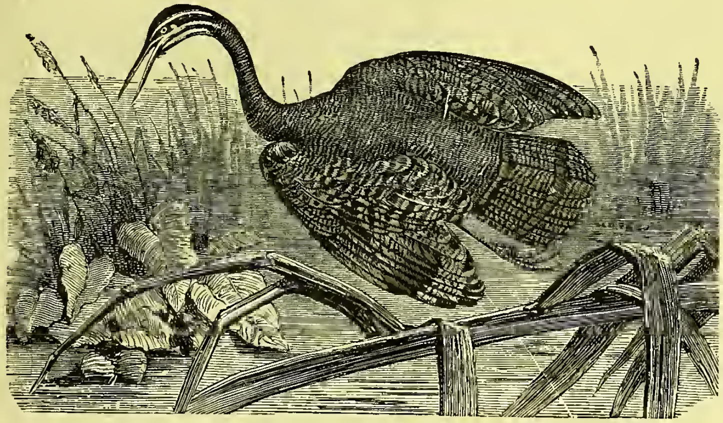
The Great White Egret (*A. alba*) is an European bird, which, on a few occasions, has been seen in England.

The Squacco Heron (*A. comata*) is found in Asia, North Africa, South Europe, and a rare straggler now and then visits England.

The Night Heron (*Nycticorax griseus*) is a rare British visitant, but is common in many parts of both Europe and Africa.

The Common Bittern (*Botaurus stellaris*), through drainage, is becoming scarce in Great Britain and Ireland, though common in parts of Europe, where still it can be said:—

> "At evening, o'er the swampy plain
> The bittern's boom comes far."


THE SUN BITTERN.

Although we associate the bittern with the rank and humid marsh, or with "desolation," yet is there a fine poetical association with its name, Ardea (Botaurus) stellaris, or

Heron of the Stars. This doubtless originated from its singular spiral flight, by means of which it ascends into the realms of space, far beyond the reach of human vision.

THE COMMON HERON AND WHITE EGRET.

The Boatbill (*Cancroma cochlearia*) is about the size of a domestic hen. Its beak more or less resembles a small boat reversed, having a strong ridge or keel down the middle of the upper mandible, and the sides spread out and bowed. This species inhabits Cayenne, Guiana, and Brazil, and chiefly frequents such parts as are near the water. In such places it perches on the trees which hang over the streams; and, like the kingfisher, drops down on the fish that swim beneath.

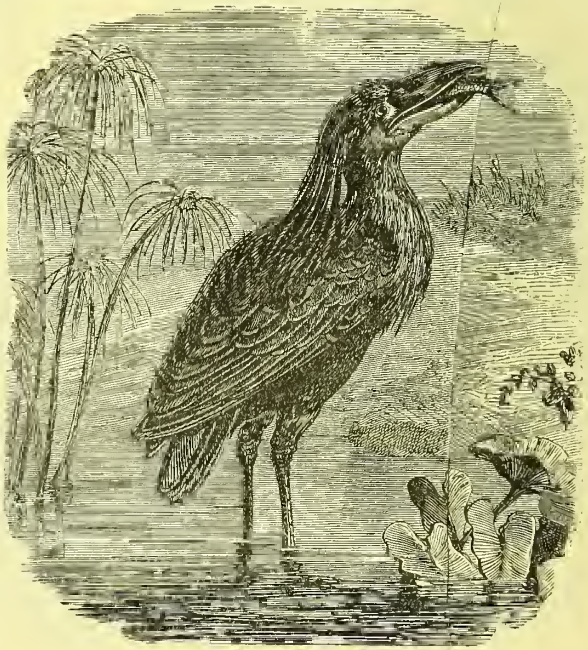
The Spoonbills and Ibises form the family called PLATALEIDÆ, and among them are birds of the greatest interest. We can only name—

The Common Spoonbill (*Platalea leucorodia*), which is found in Asia, Africa, and Europe, rarely visiting England, but is common during the summer in Holland. Its bill is very long and strong, very much flattened, and having the point very much dilated, and rounded into the form of a spoon, or spatulum; the upper mandible is channelled, and transversely furrowed at its base. These birds live in society in wooded marshes, generally not far from the mouths of rivers, and are rarely seen on the seashore. Their food consists of small fishes, spawn, and small fluviatile testaceous molluscs, as well as small reptiles and aquatic insects.

The Roseate Spoonbill (*P. ajaja*) is a beautiful bird, and a native of South America.

The Scarlet Ibis (*Ibis rubra*) comes from Pará. The Glossy Ibis (*I. falcinellus*), is a native of Africa and Europe, and occasionally visits Great Britain.

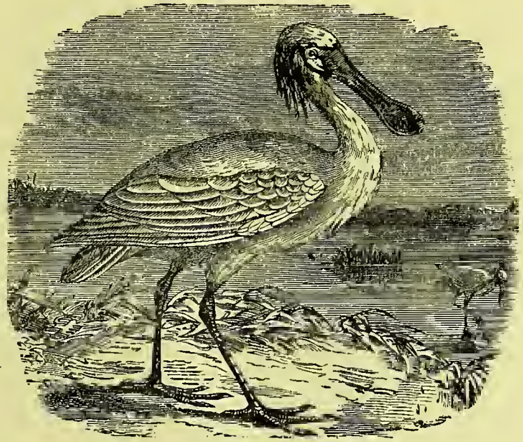
The Sacred Ibis (*Geronticus æthiopicus*) is the well-known sacred bird of the old Egyptians, who buried it with their own dead.



THE BOATBILL (*Cancroma cochlearia*).

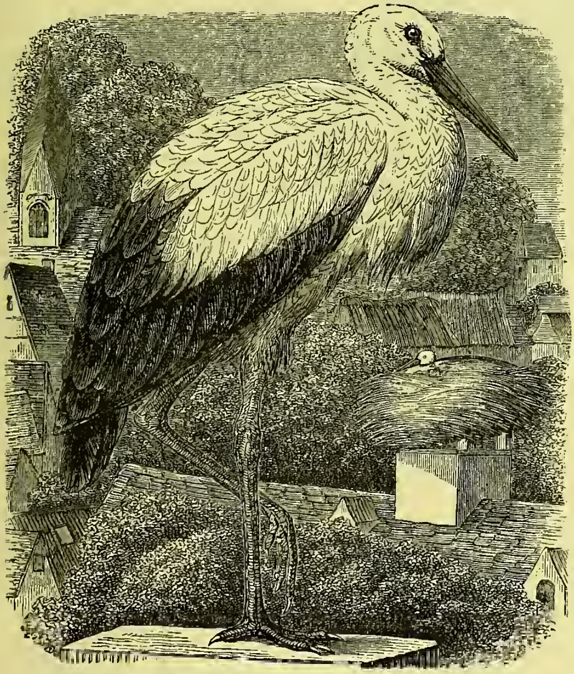
The Great Shoe Bird (*Balæniceps rex*), Consul Petherick tells us, although found only in or near water, is but rarely seen on the banks of the Nile, and then only during a short period of the year, when the land in the interior is dried up. In the summer, during the short hot season preceding the rains, it prefers the natural tanks and morasses of the interior, where the shallowness of the water distributed over a large surface affords it greater facilities for wading than the banks of the Nile. These frequently shelve off into deep water more or less abruptly, and thus furnish but comparatively few spots favourable to the support and habits of this strange bird.

The Storks form a small family (Ciconiidæ), almost all of which are found in the Old World. Two species, the Black (*Ciconia nigra*) and the White Stork (*C. alba*), are found in the British Islands. They are migratory, returning to Asia and Africa for the winter.



THE SPOONBILL (*Platalea leucorodia*).

The American Jabiru (*Mycteria americana*) is partial to salt-water lagoons. Dr. G. Bennett describes a jabiru he had at Sydney. It permitted any one to approach it, only moving away timidly when an attempt was made to touch it. It sometimes stood quite erect, or on one leg, with the other thrown out; or rested upon the tarsi, like the emeu and mooruk, and again on one leg, with the bill inclined upon the breast. It greedily devoured a pound and a half of beef, cut in small pieces, on its arrival, but it fed also on fish and reptiles. It picked up the smallest object with great readiness, though its mandibles appear unwieldy, and it clattered them together with a loud noise when catching flies. When a tub of water was placed near it, it put one leg in it; and after drinking, filled its mouth with water and threw it out again, as if rinsing the mandibles. The eyes were very large and remarkably brilliant, and yet imparted great docility of expression, making it appear—what it was—an amiable bird, familiar with all around it, and courting admiration, but on the watch for any act of aggression. When suddenly startled, it would flap its long and powerful wings, as if preparing for flight, for which its structure seemed well adapted, the whole bulk of the body being so light.



THE WHITE STORK (*Ciconia alba*).

This bird was first placed in a yard where some poultry were kept. He stared at the fowls, and they ran away on his approach, although he did not make the least attempt to molest them; and when striding round the yard, all the poultry fled before him, although it did not appear to be an intentional chase on his part. There happened to be a pugnacious, fussy little bantam-cock in the yard, who would not permit the intrusion of any stranger, and on seeing the jabiru he strutted up, with expanded and fluttering wings and ruffled feathers, in a violent state of excitement, cackling and screaming most vehemently, and making efforts, as energetic as so diminutive a bird was capable of, to frighten and drive him out of the yard. The jabiru, with his keen bright eyes, regarded the little fluttering object with cool contempt, and walked about as before; the bantam followed. At last the jabiru turned, and strode after the consequential little creature, as if to crush it under his feet; when the bantam, seeing matters take this serious turn, made off as fast as possible—like all little bullies—and did not again venture to attack so formidable an opponent. In a few days the jabiru became quite domesticated among the poultry, and they evinced no fear; even the little bantam tolerated his presence, but whether from fear or affection Dr. Bennett did not know.

THE JABIRU (*Mycteria americana*).

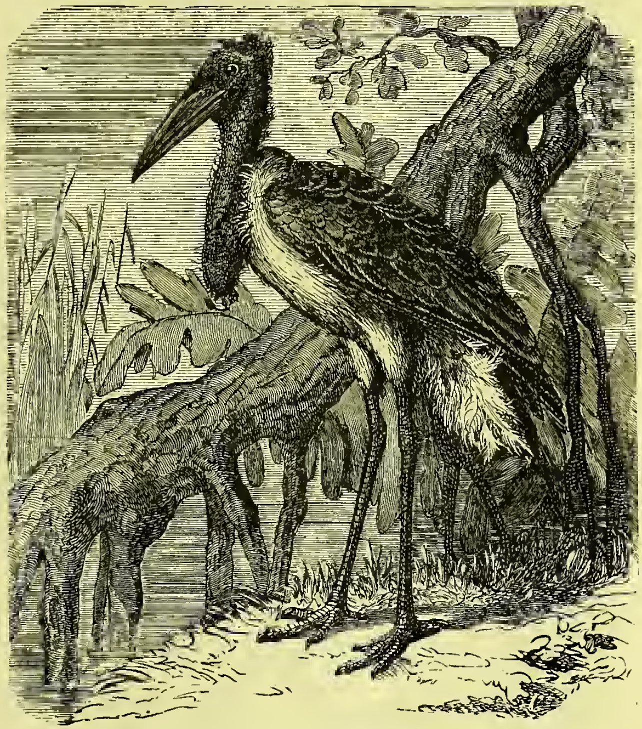
The Marabou Stork (*Leptoptilus crumeniferus*) appears to inhabit nearly the whole of tropical Africa. It very often stands as much as five feet in height The plumes imported into Europe are chiefly brought from Senegal.

Smeatham gives an amusing account of a young marabou, which had been domesticated in that part of Africa where he resided. This bird at all times took its place at dinner-time in the great hall behind its master's chair, where it remained in expectation of, as usual, sharing the meal. The servants had switches, to protect the dishes from the bird's attack previous to the arrival of the guests; yet, watching its opportunity, it would frequently snatch at some favourite morsel before they were aware of it. It has been known in this way to make a single mouthful of an entire boiled fowl. Permitted to fly at large about the island, it roosted very high among the silk-cotton-trees, from the tops of which, even at the distance of two or three miles, it would espy the servants carrying the dishes across the yard, and dash down among them as they entered the hall.

The Screamers, or Palamedeidæ, are curious aquatic birds, placed by Mr. Gray among the water hens. The forehead of the Screamer (*Palamedea cornuta*) is furnished with a singular horn-like structure, and the wing bears two spurs. It is larger than a goose, lives in pairs in the marshy districts of Brazil; and has a loud, strong voice. The Chaja (*Chauna chavaria*) has a circle of movable feathers, instead of a horn, on its head. It also inhabits Brazil, and is frequently brought up with domestic fowl. A second species (*C. derbiana*) comes from the northern coast of Columbia.

The Flamingoes, or Phœnicopteridæ, are placed by some near the ibises, by others among the swimming birds. Professor Huxley considers them to be absolutely intermediate between the geese and the herons. Their bill is singular: the upper mandible is bent downwards in the middle, at an acute angle, as if broken, the space from the angle to the point being a broad flat plate, of a somewhat oval figure; the lower mandible, which is the larger, is so adjusted as to fit the angle with its edges, its under surface being gently arched downwards. The edges of both mandibles are furnished with a row of serrations, or tooth-like eminences, those of the upper being the larger.

The use of the mandibles is, like a strainer, to allow the water to pass through, but to retain any small body, as an insect or a fish. In searching for food among the mud at the bottom of the water, the upper and not the under mandible is applied to the ground; the flat portion of its surface being well adapted for pressing close down on the soft bed of the marsh or creek. Hence, in that situation, the inferior mandible is placed uppermost, and by its motion works the disturbed and turbid water through the two, as is seen in ducks and other aquatic birds.

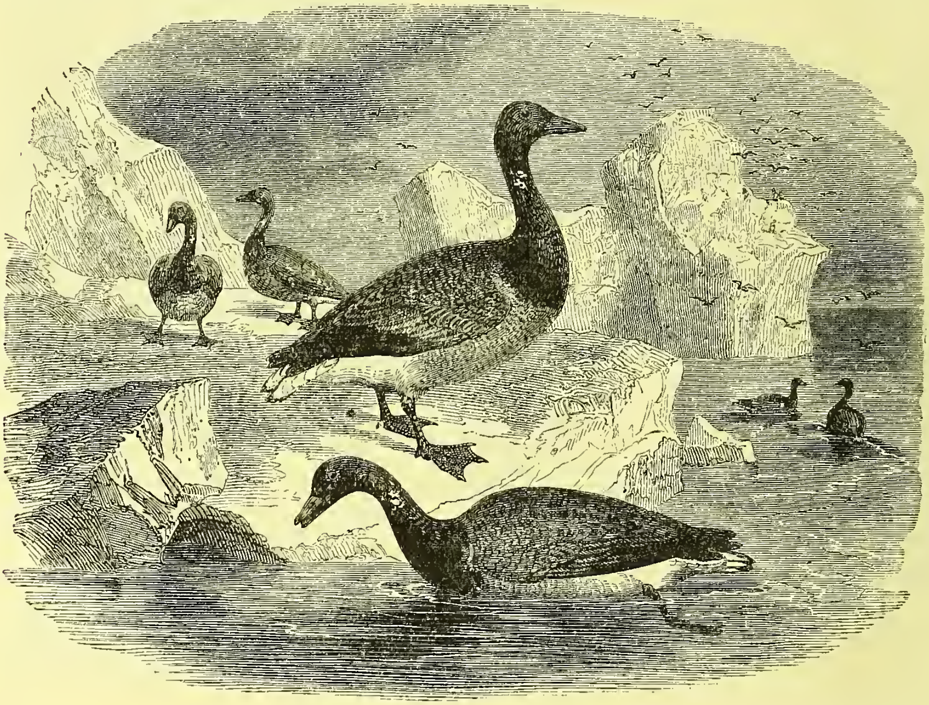


THE MARABOU STORK (*Leptoptilus crumeniferus*).

The height of the European Flamingo (*Phœnicopterus antiquorum*) is about four feet. The neck is long and slender, and the legs are greatly elongated; a web unites the three anterior toes. Its colour is very rich and brilliant, being of a fine deep scarlet on the back and roseate on the wings; the quill-feathers of the wings are jet black. The hues of the bird become more intense during succeeding years. A flock of these tall and splendid birds, moving about on the sea-beach, with their plumage reflecting the glowing rays of a tropical sun, is a spectacle never to be forgotten. Their nests are curious structures formed of earth scraped into the shape of a cone, which is hollow at the summit; in the hollow the eggs are laid, and the bird, when sitting on these, allows its legs to hang down at either side.

ORDER IX.—GEESE (*Anseres*).

This order very nearly equals that usually called *Natatores*, or Swimming Birds. Perhaps the most striking character of the group is the peculiar adaptation of the feet for swimming. There are always three toes directed forwards, and these are usually connected together by a membrane, which extends to the extremity of each toe. In some cases this web is deeply cleft, and then the web of each toe is free. The fourth toe is but little developed, and is sometimes wanting. When present, it turns backwards, and its web is connected with the web of the other toes, along the side of the foot. The feet are generally placed very far back, which gives these birds a peculiar waddling walk. But the position of the feet varies, being very far back indeed in the penguins, and not very much so in the gulls. The wings are very variously developed. Some of these birds are capable of immense flights, staying, like the albatross, for days on the wing; while others, such as the penguins, cannot fly at all. The very close, downy plumage of these birds, which covers them under their larger feathers, keeps them warm, and when dressed by the bird with the greasy secretion stored up in their tail-gland, this plumage is nearly waterproof. Many of these birds are sociable, living in immense flocks. Some few of them are polygamous; but most of them pair at the approach of the breeding season. A large number of these birds are found distributed over the world; but they are more essentially inhabitants of the temperate rather than of the tropical regions; and some of the species extend as far north as the human foot has trod. There are nearly 600 species known, and these may be grouped into the following eight families:—

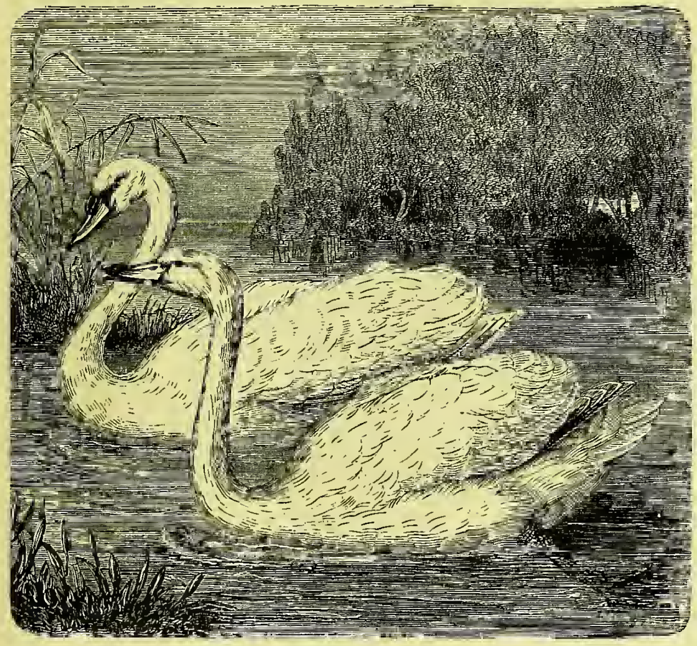


THE BRENT GOOSE (*Bernicla brenta*).

The Geese, Ducks, and Swans (Anatidæ) are found over every part of the world at present known; and it has been noticed that some of the most exquisitely-coloured species are to be met with in the temperate and Arctic regions, rather than in the tropical. Commencing with the Geese, we must find space to mention the Cereopsis Goose (*Cereopsis novæ-hollandiæ*), which is a native of Australia. It has the front of its head covered with a yellowish cere, and it has certain affinities to the wading birds.

Of the wild geese native to this country, coming to us as winter visitants, some few staying and nesting with us, we must mention the commonest, which is called the Brent Goose (*Bernicla brenta*). The popular error that the crustaceous animal called the barnicle contained the young of this species of goose lasted for many ages, and still prevails among the uneducated on the shores of all the European seas. One reason of the continuance of this error in several Roman Catholic countries, possibly, is the permission granted to eat this goose on fish-days, because it was considered to partake more of the character of a fish than of a fowl.

It may seem strange to the reader, yet the following notice, sent by Sir Robert Moray to the Royal Society, actually appears in their printed "Transactions:"—"The pedicle [of the barnicle] seems to draw and convey the matter which serves for the growth and vegetation of the shell and the little bird within it. In every shell that I opened I found a perfect sea-fowl, the little bill like that of a goose, the eye marked, the head, breast, wing, tail, and feet formed, the feathers everywhere perfectly shaped and blackish coloured, and the feet like those of other water-fowl, to my best remembrance. Nor did I ever see any of the little birds alive, nor met with anybody who did; only some credible persons have assured me that they have seen some as big as their fist."


THE HOOPER SWANS (*Cygnus ferus*).

The Grey Lag Goose (*Anser ferus*) and the White-fronted Goose (*A. albifrons*) visit our shores each winter in some numbers. Mr. Yarrell seems to consider our domestic goose a cross between these two. The Bean Goose (*A. segetum*) is a regular winter resident. The Egyptian Goose (*Chenalopex ægyptica*) is mentioned by Aristotle as haunting the banks of lakes and rivers. It is also named in two of the comedies of Aristophanes. Athenæus praises it on account of its eggs, giving them the second place, those of the peacock being assigned the first; and Ælian alludes to its cunning. Herodotus, moreover, directs special attention to the Egyptian goose. He shows it was held sacred by the Egyptians, and modern travellers have found evidence of its being at least a favourite dish among the priests. Mr. Salt remarks: "Horus Apollo says the old geese stay with their young in the most imminent danger at the risk of their own lives, which I have myself frequently witnessed. Vulpanser is the Goose of the Nile; and wherever this goose is represented on the walls of the temple in colours, the resemblance may be clearly traced." It is also stated that a place in Upper Egypt had its name Chenoboscion, or Chenoboscia ("goose pens"), from these birds being fed there, probably for sale. These, however, may have been sacred geese, as the goose is said to have been a bird under the care of Isis.

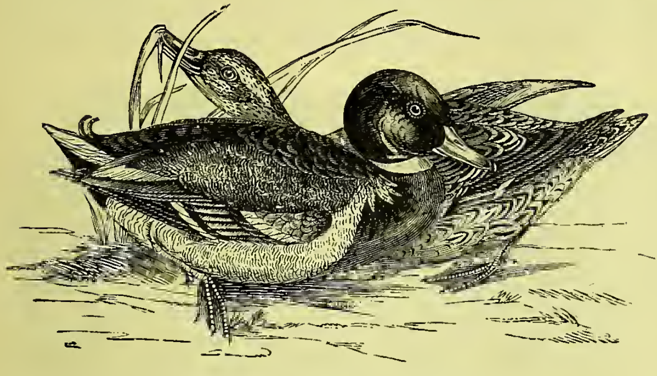
The Spur-winged Goose (*Plectropterus gambensis*) is a native of West Africa.

Of the Swans, noted for their long neck and as being among the most graceful of the aquatic birds, we must mention the Whooping Swan (*Cygnus ferus*), the Common Swan (*C. olor*), both natives of Europe, and to be found, along with Berwick's Swan (*C. berwickii*), in Great Britain. The Black Swan (*C. atratus*) comes from Australia, and the Black-necked Swan (*C. nigricollis*) from Southern America.

The Ducks form a large and well-marked section of this family, and might easily be divided into minor groups. In the Mergansers the bill is long, thin, and hooked, and they are chiefly fish-eaters. The Goosander (*Mergus merganser*) is an annual visitor to the British islands, chiefly to fresh water; and the Red-breasted Merganser (*M. serrator*) is quite indigenous to Ireland. The Snew (*M. albellus*) and the Hooded Merganser (*M. cucullatus*) are met with less frequently.

EIDER DUCKS (*Somateria mollissima*).

In the Pochards the bill is broad and high; they are generally marine. The drakes are often very beautiful birds. The Long-tailed Duck (*Fuligula glacialis*) breeds in the extreme north, only rarely visiting our shores. The Eider Duck (*Somateria mollissima*) inhabits the Arctic regions. It is killed by the Greenlanders for the sake of its flesh and its skin; the former, though rank, is valued as food; the latter yields clothing of singular warmth and comfort. "The down of this bird" is of such value, that, when in purity, it is sold in Lapland for two rix-dollars a pound. It is extremely soft and warm, and so light and expansive that a couple of handfuls squeezed together are sufficient to fill a quilt five feet square.

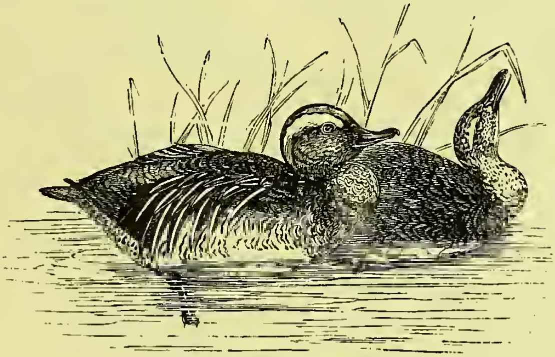


THE WILD DUCK (*Anas boschas*).

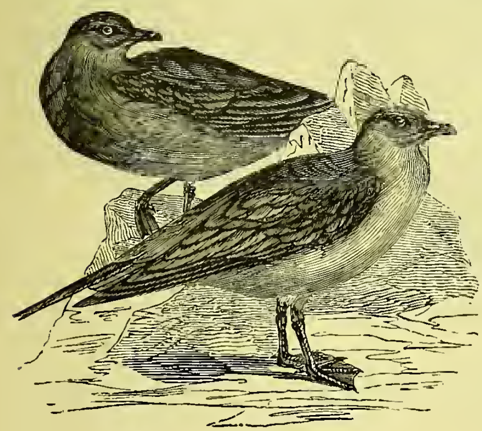
The King Duck (*Somaterid spectabilis*) is also an exceedingly beautiful bird, sometimes to be found breeding in the Orkneys.

The Canvas-back Duck (*Æthya valisneria*), so much prized by the epicure, is a native of North America.

The true wild ducks generally have their fourth toe scarcely at all webbed. We can only allude to the Mallard, or Wild Duck (*Anas boschas*), the original of all the ordinary domestic varieties. It is an inhabitant of all the countries of Europe, especially towards the north; in other parts of this continent it appears to be more or less a bird of passage. It is also abundant in North America. It is plentiful in Britain at all seasons, merely quitting the more exposed situations at the approach of winter, and taking shelter in the valleys; or, in case of a severe winter, visiting the estuaries. In a wild state the mallard always pairs, and during the period of incubation the male, although he takes no part in the process, always keeps in the neighbourhood of the female; and it is singular that half-bred birds between the wild and tame varieties always exhibit the same habit, although the ordinary domestic drakes are polygamous, always endeavouring to get as many wives as they can.



THE TEAL (*Querquedula creeca*).

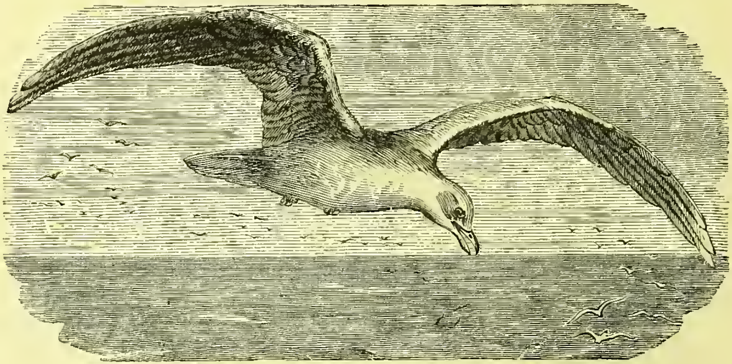


THE SKUA (*Lestris catarractes*).

Of other species we must mention the Teal (*Querquedula creeca*); the Widgeon (*Mareca penelope*); the Pintail (*Dafila acuta*); the Mandarin Duck (*Aix galericulata*); the Common Shelldrake (*Vulpanser tadorna*). Of the Tree Ducks, chiefly to be found in the tropics, we may allude to the Red-billed Tree Duck of America (*Denarocygna autumnalis*) and the Indian Tree Duck (*D. arcuata*).

The Gulls and Terns (LARIDÆ) inhabit the shores and islands of every zone; most of them feed on fish. The Skuas, of which several species are obtained around the British shores, have the remarkable habit of accompanying other birds when fishing, and compelling them to disgorge a portion of their prey, on which they at once pounce. They are robbers on the ocean. The Skua (*Lestris catarractes*) is to be seen occasionally around our coasts. Of the Gulls, perhaps the Common Gull (*Larus canus*) best deserves its name, for it abounds everywhere, though it is scarcely more common than the Herring Gull (*L. argentatus*) or the Black-headed Gull (*L. ridibundus*). The Great Black-backed Gull (*L. marinus*) is one of the largest and finest of the species.

The Ivory Gull (*Pagophila eburnea*) is known to breed in the Arctic regions; it on rare occasions visits the shores of Ireland and Scotland.

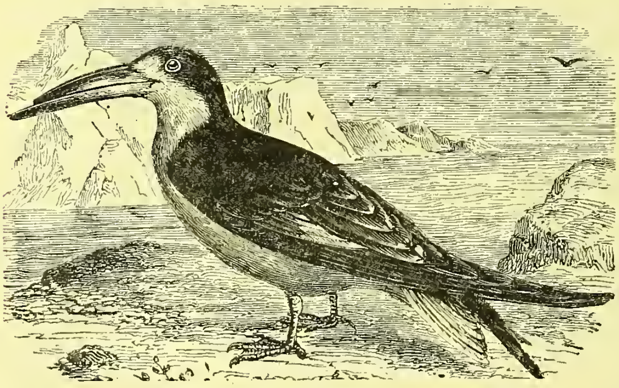


THE COMMON GULL (*Larus canus*).

The Sea Swallows, or Terns, are very active on the wing, living in great flocks and feeding on fish. On our coasts these lovely birds are only summer visitants, coming to breed. Many species never leave the tropical islands or shores, where they congregate in countless thousands. Some few species are known to be insect-feeders, capturing these on the wing.

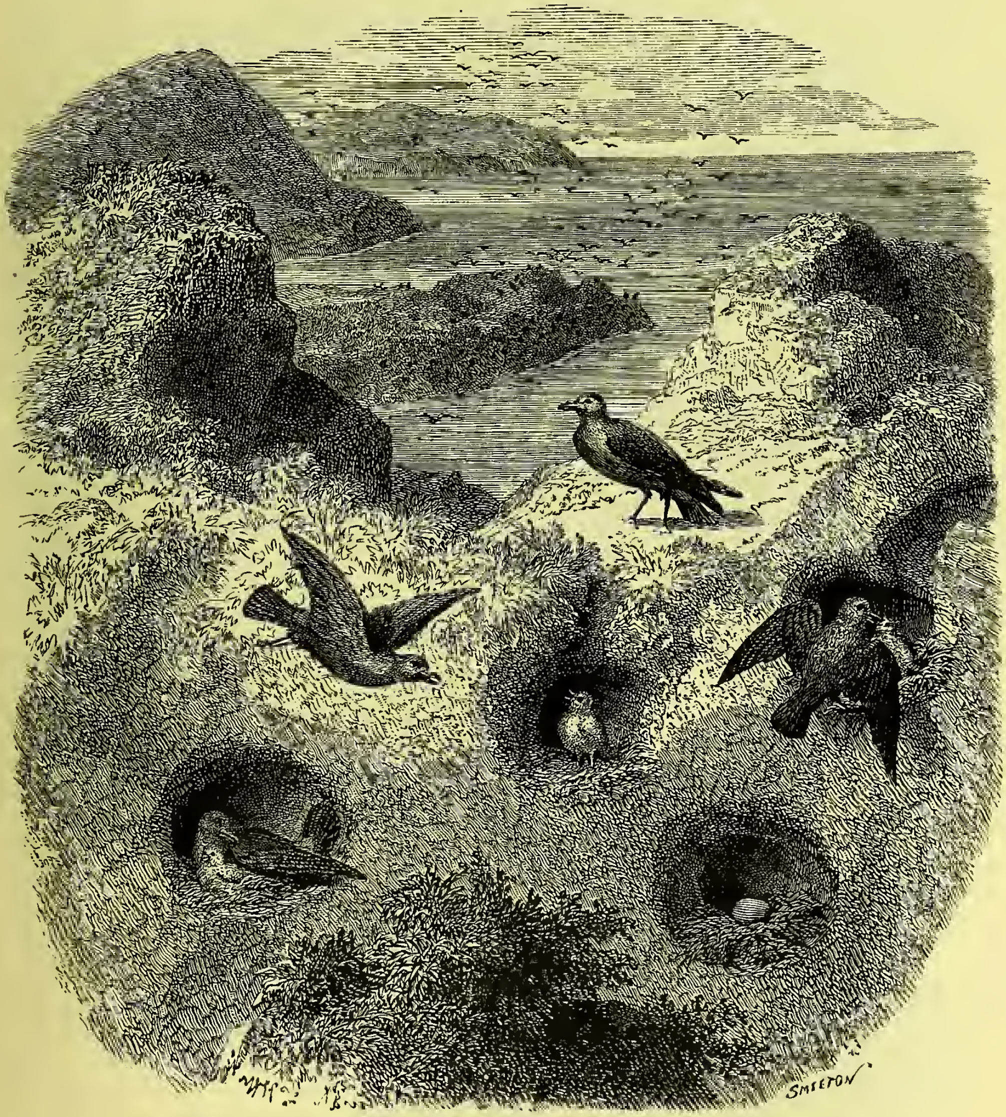
The Roseate Tern (*Sterna paradisea*) is one of our regular summer visitants, as is also the Sea Swallow (*S. hirundo*). Of the former, Audubon thus writes:—"Beautiful indeed are terns of every kind, but the roseate excels the rest, if not in form, yet in the lovely hue of its breast. I had never [until the 28th of April, 1832, at the islet named Indian Key] seen a bird of this species before, and as the unscathed hundreds arose and danced as it were in the air, I thought them the humming-birds of the sea, so light and graceful were their movements."

The beautiful snow-white Gœland (*Gygis candida*) of the tropics, which builds its nest in trees, or rather, lays its eggs in the hollow of a tree-stem without a nest, belongs to this family, and is allied to the genus Hydrochelidon, of which one species, the Black Tern (*H. nigra*), sometimes visits Great Britain. The Noddy Tern (*Anous stolidus*) is a rare English bird. It is sometimes caught on board vessels; and it often builds its nest on bushes. The Scissors-bill (*Rhynchops nigra*) is remarkable for its long and much compressed beak, the lower mandible being much longer than the upper, rather flatter, and shutting into the upper like a knife-blade into the handle. This beak is orange-red at the base, deepening into black at the tip. The scissors-bill skims just over the surface of the sea, its knife-like bill cutting through the water, and picking up the crustaceans, molluscs, and fish that come to the surface. While thus darting along the bird utters loud and exulting cries. It does not, however, trust solely to the wide sea for its food, for, according to Leeson, who says he was an eye-witness of the scene, the bird feeds much upon bivalves, adroitly inserting its beak into their shells as they lie gaping, and then banging the shell against a rock or stone so as to break the hinge and expose the inhabitant, which is immediately scooped out and swallowed. The scissors-bill is found along the coast of America and part of Africa.



THE SCISSORS BILL (*Rhynchops nigra*).

The next family is that of the PETRELS, OR PROCELLARIIDÆ. The Stormy Petrel, or Mother Cary's Chicken (*Procellaria pelagica*), is to be seen by navigators in every part of the ocean skimming over the surface of a heavy-rolling sea. Before a storm these birds flock under the wake of a ship, and are looked upon by sailors as foreboding evil. "But," says that accurate naturalist, Alexander Wilson, "as well might they curse the midnight lighthouse, that, star-like, guides them on their watery way, or the buoy that warns them of the sunken rocks below, as this harmless wanderer, whose manner informs them of the approach of the storm, and thereby enables them to prepare for it." It is often to be seen off the coasts of the British Islands. The Fulmar Petrel (*Fulmarus glacialis*), another British species of this family, is especially abundant in the Arctic Seas, where it is a close attendant upon the whale-fishers, snapping up any morsels of blubber that may fall into the water; and in its avidity for this tempting fare it often approaches so closely to the men engaged

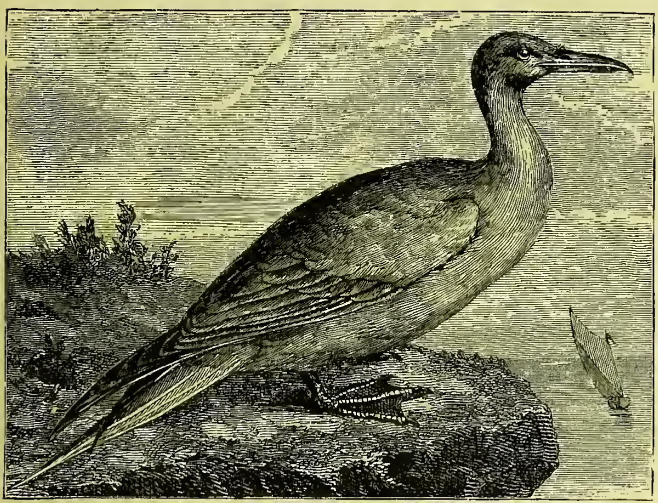


THE FULMAR PETREL (*Fulmarus glacialis*).

in cutting away the blubber as to be easily knocked on the head with a boat-hook, or even taken by the hand. These birds breed on one spot on the British coasts, the island of St. Kilda, where they are of great importance to the inhabitants, who not only eat the flesh and the eggs, but also collect the oil vomited by the birds when seized, and boil down the young birds for the sake of the fat yielded by them. The oil is burnt in lamps, and is also regarded as possessed of valuable medicinal properties. As the birds make their nests only on the ledges of nearly perpendicular rocks, their pursuit is a matter of great danger, the fowler being lowered by a rope from the top of a precipice.

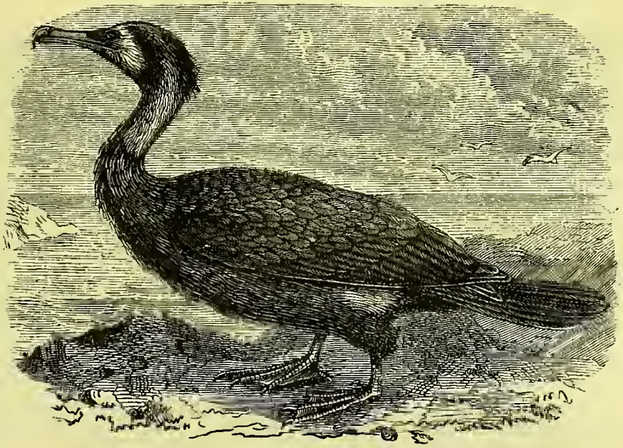
THE ALBATROSS (*Diomedea exulans*).

The Great Albatross (*Diomedea exulans*) is almost the largest of all the aquatic birds. It measures three feet in length, while the extent of its wings is variously stated. Forster says it is about ten feet; Parkins eleven feet seven inches; Cook eleven feet; another authority says twelve feet; a specimen in the Leverian Museum measured thirteen feet; and Ives describes one shot off the Cape of Good Hope, which measured seventeen and a half from wing to wing. "How powerful," says Dr. Arnott, "must be the wing-muscles of birds which sustain themselves in the air for hours together; and this bird is to be seen in the stormy solitude of the Southern Ocean accompanying ships for whole days without resting on the waves." When once on the wing their flight is rapid. It is apparently performed with great ease, as they appear to do little more than sway themselves in the air, sometimes inclining to the left, and at other times to the right, gliding with great rapidity over the surface of the sea. It is only in bad weather that their flight is at any great elevation.

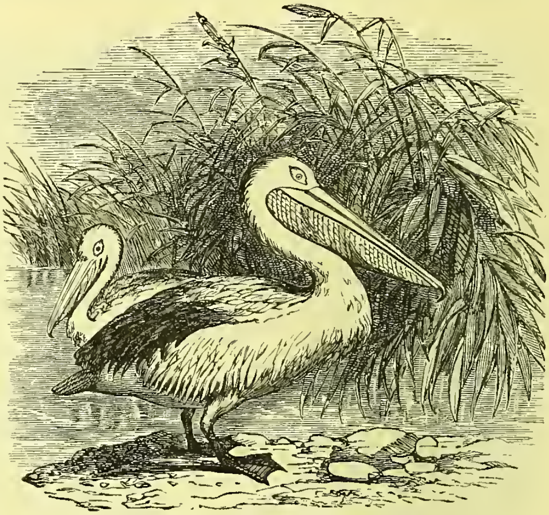

THE GANNET (*Sula bassana*).

The Pelicans (PELICANIDÆ) are most numerous in the tropics, less so perhaps in the temperate regions; but a few species extend to the Arctic regions. Perhaps the best known is the Gannet, or Solan Goose (*Sula bassana*). The Bass Rock, at the entrance of the Frith of Forth, and some of our northern isles, are among the annual resorts of this bird, for the purpose of incubation; the nests are placed on the ledges and projections of the rocks, where multitudes breed in harmony together.

The Common Cormorant (*Phalacrocorax carbo*) is common all around our shores. This bird swims very low in the water; even in the sea the body is deeply immersed, little more than the neck and head being visible above the surface. It dives most expertly, pursuing the fish that forms its food with great activity under the water. It flies with the neck outstretched, and may often be seen drying its drenched plumage on the shore or on insulated rocks. Nearly equally common is the Shag (*P. cristatus*). One of the most remarkable species is the Fishing Cormorant (*P. sinensis*), an inhabitant of China, where it is regularly trained and employed in fishing. Mr. Fortune, who saw them frequently engaged in this manner during his travels in the interior of China, says that their docility is so remarkable that had he not witnessed their proceedings he would have had great difficulty in believing the statements of previous authors. They are taken out in small boats, each with a string tied round his neck to prevent his swallowing the fish when caught, and on receiving the word of command from their masters, immediately quit the boats and scatter themselves over the surface of the water,


THE CORMORANT (*Phalacrocorax carbo*).

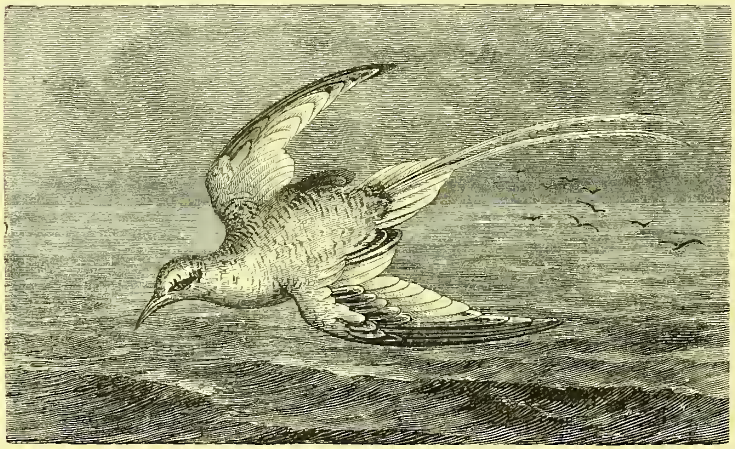
looking out for prey. The moment they perceive a fish below them they dive down upon it, and on rising again with their prey they bring it to their masters with the docility of a dog, allow themselves to be dragged in, disgorge the fish, and then return to their occupation.


THE PELICAN (*Pelecanus onocrotalus*).

The Pelican (*Pelecanus onocrotalus*) is found in the east and south of Europe, and in North Africa; it is perhaps the largest of the swimming birds, and has a pouch so highly dilatable as to be capable of containing two gallons of water; the number of fish it can hold may therefore be easily imagined.

The Frigate Bird (*Fregetta aquila*) is a very singular bird, with a long and forked tail. "It has," says Mr. Darwin, "a noble appearance when seen soaring in a flock at a stupendous height (at which time it merits the name of the Condor of the Ocean), or when many together are darting in complicated evolutions, but with the most admirable skill, at the same floating object. They seem to take their food quickly, for between each descent they raise themselves on high, and descend again with a swift and true aim. If the object (such as offal thrown overboard) sinks more than six or eight inches beneath the surface, it is lost to the frigate bird. I was informed at Ascension that when the little turtles break their shells and run to the water's edge, these birds attend in numbers, and pick up the little animals (being thus very injurious to the turtle-fishing) off the sand in the same manner as they do from the sea."

The Tropic Bird (*Phaëthon æthereus*), so well known to navigators, is at once distinguished by its two long slender tail-feathers. Their length of wing and comparatively feeble feet proclaim them formed for flight, and accordingly they disport far out at sea. They rarely repair to the land for any length of time, and when there, at the period of nidification, perch on rocks and trees. Their habitual domicile in the torrid zone does not separate them from the land, and they can reach, as they do every night, the isles and lofty rocks that serve them as a place of refuge.


THE TROPIC BIRD (*Phaëthon æthereus*).

The Darter (*Plotus anhinga*) is found in the warmer parts of the world, though principally in America and Africa, where it haunts the margins of rivers and lakes, perching upon the trees or flying over the surface until a fish comes in sight, when it immediately plunges down upon it and rarely misses its aim. When swimming the body is generally concealed under water, and sometimes only the head is visible. Its favourite position is upon the branches of trees overhanging the water; and when disturbed it is said to glide into the water so silently that the agitation of the water is not greater than would be produced by an eel.

THE DARTER *(Plotus anhinga).*

The Penguins (SPHENISCIDÆ) are almost altogether confined to the Antarctic and South temperate regions, being found in the more southern parts of South America, Australia, New Zealand, and one or two species are found at the Cape of Good Hope.

The Jackass Penguin (*Eudyptes demersa*) is described by Mr. Charles Darwin:— "When at sea and fishing, it comes to the surface for the purpose of breathing with such a spring, and dives again so instantaneously, that I defy any one at first sight to be sure that it is not a fish leaping for sport. On shore, from the extremely backward position of their feet, the penguins are only able to stand in a very upright attitude; and in this position they may be seen in countless multitudes, arranged in regular ranks along the barren shores which they frequent. When in motion on land, however, they employ their wings in place of an anterior pair of legs, and by their assistance contrive to scuttle along so rapidly that, according to Mr. Darwin, when they are in motion amongst the tussocks of grass, they might readily be mistaken for quadrupeds. When disturbed in their resting places, these birds exhibit a bold and determined demeanour, fighting bravely with their beaks in their endeavours to reach the sea."

THE KING PENGUIN (*Aptenodytes peunantii*).

The largest known Penguin (*Spheniscus magellanicus*) is found at Cape Horn; and the species of Aptenodytes are confined to a few Antarctic islands. The King Penguin (*A. peunantii*) is found in the South Pacific Ocean.

The NORTHERN DIVERS, OR COLYMBIDÆ, form a small family by themselves, chiefly met with in the Northern continents; at least two species are regular winter visitants to our shores. One of these, the Great Northern Diver (*Colymbus glacialis*), is a very handsome bird, and measures sometimes nearly three feet from the tip of its beak to the end of its tail.

The GREBES, OR PODICEPIDÆ, are generally associated with the Divers, but they differ very much in the structure of their feet. The commonest British species is the Dabchick (*Podiceps minor*), a small bird of nine or ten inches in length, which is found abundantly in most parts of the country about lakes and fish-ponds. This little bird is exceedingly active in the water, swimming and diving with great ease, and remaining submerged for a considerable time. It progresses under water with great rapidity by the aid of both wings and feet. The larger grebes do not appear to make use of their wings in this manner. The Eared Grebe (*Podiceps auritus*) is a rare British bird.

THE EARED GREBE (*Podiceps auritus*).

The Auks, Puffins, and Guillemots form the last family (ALCIDÆ) of the swimming-birds. They are for the most part natives of the North temperate and Arctic regions.

The Great Auk (*Alca impennis*) is now extinct. This bird, formerly to be found in several parts of Northern Europe, in Labrador, and very rarely in the British Isles, has not been observed for many years, and is thought to be as completely extinct as the dodo. Almost the last living specimens known were seen in the Orkneys, and were quite familiar to the inhabitants under the name of the King and Queen of the Auks.

The Razor-Bill (*Alca torda*) visits annually, for nidification, lofty cliffs around the coast. Montagu, writing from Devonshire, remarks that "the razor-bill is not seen with us in winter;" and Selby observes, with regard to the birds bred in Great Britain, that "in winter their place is supplied in Scotland, and sparingly also along the English coast, from the colonies that breed in higher latitudes." Audubon gives a good personal narrative of his visits to the razor-bill's breeding haunts on the coast of North America.

The Puffin, or Sea Parrot (*Fratercula arctica*), makes its appearance at its customary breeding-places about the middle of April, and departs in August to winter on the southern coasts of Spain, Italy, and other parts of Southern Europe. The length of the bird is thirteen inches. The bill is deeply furrowed, and bluish-grey at the base, the middle part orange-red, which deepens into bright red at the tip; the legs are orange-red. Perched on the cliff of the craggy precipice, the puffin looks down with eager gaze on the sea beneath, and skilfully throws itself into the abyss. Here it expertly swims and dives, its food consisting of the smaller fishes, and especially the young of the sprat.

THE GREAT AUK, PUFFINS, AND GUILLEMOTS.

The Common Guillemot (*Uria troile*), according to Mr. Yarrell, "about the middle of May, with many other species of birds frequenting rocks at that season, converge to particular points, where, from the numbers that congregate and the bustle apparent among them, confusion of interests and localities might be expected; but, on the contrary, it will be found that the guillemots occupy one station or line of ledges upon the rock, the razor-bills another, the puffins a third, the kittiwake gulls a fourth; while the most inaccessible pinnacles seem to be left for the use of the lesser black-backed and the herring gulls. Two distinct species scarcely ever breed by the side of each other."

ORDER X.—OSTRICHES (*Struthiones*).

This order contains not more than twenty species, which are only to be found in Africa, South America, and Australasia. Among the birds there are none more remarkable. From their powers of running they are often called Cursores. They are nearly all of them large birds, with big legs, and their wings are reduced to a most rudimentary condition, so that none of them are at all capable of flight. The anterior toes are strong, either two or three in number, the hinder toe, except in the apteryx, being wanting. The plumage is very peculiar, the feather barbs being separate and hair-like; often the head and neck are naked, or down-covered, and the head is variously furnished with a horny crest, and the neck is sometimes adorned with wattles. The bill is usually rather short and depressed, but it is very long in the apteryx, and in this bird the nostrils are placed at its tip.

THE OSTRICH (*Struthio camelus*).

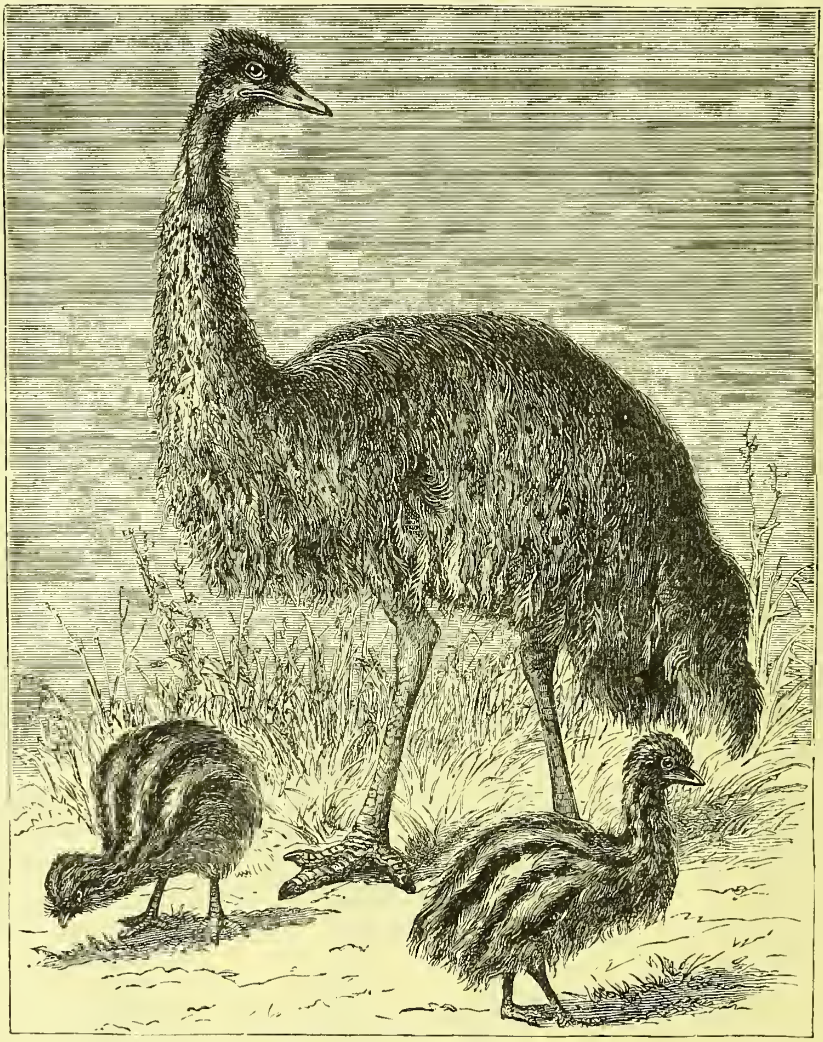
Of the Ostriches, or Struthionidæ, the best known is the Ostrich of the Old World (*Struthio camelus*), found inhabiting the desert regions of North, East, and South Africa, and extending into Arabia. Dr. Sclater tells us "that once it was generally supposed to lay its eggs in the desert, and to leave them to be hatched by the heat of the sun; and this belief appears to have been current ever since the Book of Job (one of the earliest of the Holy Scriptures) was written: but now it is known with certainty, from the observations of M. Noel Suchet, Director of the Zoological Gardens at Marseilles, that the normal habits of the ostrich on this point do not differ materially from those of its allies of the same family. In March, 1861, a pair of ostriches were placed in a quiet enclosure near Marseilles for the purpose of inducing them to breed. Fifteen eggs were deposited by the female in an excavation made in the sand by the two birds working alternately, at intervals of two days each, the number being complete on April 20th. The male then took up his position on the eggs, and the young birds were hatched on the 3rd of June, being forty-five days after incubation had commenced. This, however, would appear to have been before the expiration of the usual period of incubation, which, according to the observations of M. Hardy, of Algiers, lasts usually from fifty-six to sixty days."

The Rheas inhabit South America. Three species are known. The Common Rhea (*Rhea americana*) has bred in the London Zoological Gardens, the male bird making the nest, arranging the eggs, and performing the whole duties of incubation. The eggs were hatched out in thirty-five days.

The Great-billed Rhea (*R. macrorhyncha*, Sclater) is smaller than the Common Rhea, though with a longer and larger bill. Darwin's Rhea (*R. darwinii*) is found in Patagonia.

THE RHEA (*Rhea americana*).

The Cassiowaries and the Emeus (CASUARIIDÆ) are confined to Australia and some of the Malay group of islands. The Common Cassiowary (*Casuarius galeatus*) is found in Ceram. It seems to have been unknown in Europe until the sixteenth century, when the Dutch, on their return from their first voyage to India, brought one from the island of Java. This bird was given them by the then reigning prince. For a considerable time it was exhibited in Amsterdam for money; it was then sold to the Emperor of Germany. Since that period these birds have been frequently brought into Europe, and as they bear its climate well, they are to be found in various places. The head of the cassiowary is surmounted with a bony prominence, covered with a horny substance; the skin of the head and upper part of the neck are naked, and tinged with cœrulean blue and flame-colour; the bird has pendent wattles, like those of the turkey-cock; the wings are furnished with some stiff featherless quills; and the nail of the internal toe is much the strongest. Its height, when erect, is about five feet; it feeds on seeds and herbage. There are eight other species, of which one of the most remarkable is the Mooruk (*C. bennettii*), from New Britain.



THE EMEU (*Dromæus novæ-hollandiæ*).

The Emeu (*Dromæus novæ-hollandiæ*) is a native of Australia. It is stated to attain a height of more than six feet. In form it closely resembles the ostrich, but is lower in the legs, shorter in the neck, and of a more thick-set and clumsy make. At a distance, its feathers have more the appearance of hair than of plumage; its nest is a mere hollow excavated in the earth. The dark-green eggs are six or seven in number. The birds appear to be tolerably constant in pairing, and the male bird sits and hatches the young, whilst the female watches and guards the nest.

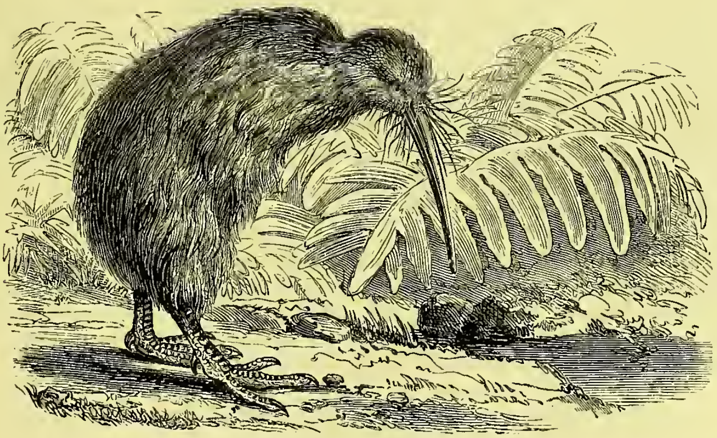
These birds will take water. Captain Sturt saw two of them in the act of swimming. They appear to be gregarious, and not very shy in some localities. Major Mitchell, in his excursion towards Port Philip, found them very numerous on the open downs, and their curiosity brought them to stare at the horses of the party, apparently unconscious of the presence of the riders. In one flock he counted thirty-nine, and they came so near that the traveller, having no rifle with him, discharged a pistol at them, but without effect. The period of incubation would appear to be eight weeks.

The species of apteryx must be formed into a family by themselves (APTERYGIDÆ), and this is one of the most remarkable of all the families of birds.

The Apteryx (*Apteryx australis*) is a native of New Zealand. It is called "Kiwi" by the natives, who used to hunt it for the sake of its flesh, of which they are extremely fond. Until the approach of night it buries itself in the recesses of the forests, and then ventures forth in couples in search of food, which they discover in darkness with the greatest ease. The cry of this bird resembles the sound of a whistle, and it is by imitating this that the hunters are able to take it. Sometimes it is chased by dogs, and at others secured by suddenly coming upon it with a lighted torch, when it makes no attempt at flight.

To Dr. Sclater we are indebted for the following facts:—"Several years ago an old native, who had been a great kiwi-hunter, in the times when the kiwi were plentiful, told me a strange tale about the manner in which the kiwi hatches its eggs. I, of course, cannot vouch for the correctness of the story, but think it worth mentioning. He said the kiwi did not sit, like other birds, upon the egg, but under it, first burying the egg in the ground to a considerable depth. Fortunately, we are able to test these statements to a certain extent by the observations of the habits of the female Apteryx mantelli in our London Zoological Gardens, which, although unmated, has for several years produced eggs.

"This apteryx laid her first egg on the 9th of June, 1859, as I have already recorded in the 'Proceedings.' Since then she has laid nine others, generally producing one early in the year, and the second about three months after the first: altogether two eggs in each year. She has more than once manifested a disposition to sit upon her egg, having been discovered, after its deposition, placed above it, just in such an attitude as would be assumed if this were the case, and resisting all attempts to move her from her position. It would appear probable, therefore—1. That the apteryx lays one egg only at a time. 2. That this is deposited within a hollow tree, as recorded by Mr. Webster, and that the female incubates thereon. 3. That the apteryx breeds twice a year."



THE APTERYX (*Apteryx australis*).

CLASS III.—REPTILIA.

THE Reptiles form the third class of the sub-kingdom of the Vertebrates. They are air-breathing, cold-blooded creatures. By cold-blooded it is meant that the temperature of their blood is, in a great measure, dependent on the medium (air or water) in which they live for its degree of heat; in this differing widely from the animals forming the two former classes.

The appendages to the skin are of a scaly character. The anterior limbs are sometimes entirely absent, and even where all the four feet are developed, they rarely suffice to support the animal off the ground. "Upon thy belly shalt thou go" is true of all the members of this class. They all breathe by means of lungs, but in all the blood going to the lungs to be purified (oxygenated) mingles, more or less, with the blood returning from the lungs which has been oxygenated. They are all either, as birds are, oviparous, or ovoviviparous—that is, the eggs are hatched within the body of the mother. Pursuing the plan adopted in the first two classes, we very briefly will consider the following systems:—

THE TEGUMENTARY SYSTEM is often very greatly developed in this class, and few can even think of a serpent without associating with it the idea of scales. These scales are not developed, like feathers, within little pit or sac-like depressions of the skin, but are, as it were, plates of horny skin, into which portions of the true skin are prolonged; sometimes absolute bony pieces (scutes) are combined with these scales, and so form a remarkable bony-skin-skeleton; so that we have some reptiles clad in coats of scutes (Loricata), and others clad in coats of scales (Squamata). In some the scales are cast off at intervals in small detached pieces (as in the lizards); in others the whole scaly covering is cast off in a single piece (as in most snakes).

In some, the layers of the skin are so constituted as to enable the various colours deposited therein to change very rapidly, and these colours are often of great brilliancy. These phenomena we will have to notice when we come to the chameleon and some of the lizards.

A very striking skin structure is to be met with in the rattle-snakes. Instead of the horny portion in the vicinity of the tail forming the ordinary scales, it is here arranged in a series of rings, somewhat loosely connected together. These pieces vary in number, from one to upwards, it is said, of twenty, and the series constitutes the well-known rattle of these venomous snakes.

THE OSSEOUS SYSTEM is well developed, and the ossification of the parts of the skeleton is very complete. The skull is much less capacious, in proportion to size, than that to be met with among birds. But the great bulk of the head is taken up with the jaw-bones. The skull is joined to the first neck vertebra by one articulating process (condyle). Sometimes the upper jaw-bones are firmly fixed to the skull-bones, sometimes they are movable. The lower jaw is composed of many pieces: from four to five in the snakes, and often double this number in the crocodiles and lizards; while in the tortoises, when fully grown, this jaw presents the appearance of a single bone. The bone known as the quadrate-bone, which we first met with in the birds, is among this class sometimes movable, and sometimes not.

The teeth in most reptiles are placed on the jaws, but in some few cases are also found on the palate-bones and on the ploughshare-bone (vomer). In the crocodiles the teeth have sockets, but in many reptiles they are only inserted into a furrow in the bones, to which they are attached by muscles (flesh). In the tortoises teeth are absent, the jaws being simply armed with horny beaks, like the bills of birds. The teeth in reptiles can be reproduced as often as they are shed. In the venomous snakes, the teeth (fangs) are few in number, are generally very long, sharp-pointed, and hollow, forming a series of tubes, through which the poison from the glands is carried; generally but one pair of these fangs is present, but rudimentary ones, to replace these if destroyed, are always ready. The teeth, in this class, serve not so much for dividing or masticating their prey as for holding it fast, and this will, in part, account for these teeth not being divided as in the mammals, into incisors, canines, and molars.

The spinal column in this class differs greatly in length, and thereby indicates a very much greater diversity in form among the members of the class that we met with in the mammals or the birds. Thus, while in some tortoises we find as few as 27 individual vertebræ, yet in the slow worm (Anguis) there are 111, and in some of the snakes over 300 (305 in the boa-constrictor). The neck is generally short. In the snakes the ribs commence at the third neck vertebra, in the chameleon at the fourth, while in the tortoises all the eight neck vertebræ are very movable and ribless. In most reptiles the bodies of the vertebræ are convex on their posterior surface, and concave on their anterior; and in some of the serpents these convexities and concavities form a regular ball and socket joint, giving to their spinal column a wondrous mobility. In a very few instances the bodies of the vertebræ are concave (Hatteria) at both ends, as in most fishes, and in the tortoises the two extremities are flat, and united by a little disc-like portion of a semi-bony nature. In most reptiles the ribs are, in greater or lesser proportion, united in front to a breast-bone (sternum), which in the crocodiles runs back to the very pelvis. In the snakes the ribs are all perfectly free at their extremity, whilst in the tortoises these bones are immovably fixed, constituting, in a great measure, the bony case that so encloses these creatures. In the greater number of the lizards, crocodiles, and tortoises, the limbs are well developed, but no limbs are present in the Ophidia (snakes), except only in the genus Chirotes, placed by some among the Amphisbænæ; but traces of hind limbs are to be found in some serpents hidden beneath the skin. When present, the four limbs are composed of practically the same parts as in mammals. It ought to be noted, however, that the upper arm-bone (humerus) and the thigh-bone (femur) are directed outwards, so as to place the elbows and knees away from the trunk. In general, the whole of the toes, which are usually five in number, are extended forwards from the extremity of the limb; but in the chameleons they form two sets, one with two, the other with three toes, forming thus a kind of parrot-like leg, of immense assistance to the creature in its arboreal life. In some crocodiles and tortoises a membrane unites these toes, fitting them for an aquatic life; while in some land-tortoises the toes form a thickened fleshy mass, like a small elephant's foot; and in the turtles they form a broad and powerful fin-like organ.

The bones forming the shoulder girdle are, as might be expected, absent in the serpents, and the collar-bone is wanting in the crocodiles and tortoises. The bones forming the pelvic girdle are, in the crocodiles and tortoises, three in number on each side, but only a single bone is found in the lizards, and there is no bony pelvic girdle in the snakes.

THE ALIMENTARY SYSTEM.—The tongue in the reptiles is not used for capturing food, but rather as an organ for feeling. It is spoon-shaped and immovable in the tortoises and crocodiles, but it is long, protrusible, and often bifid, in the snakes and lizards, while in the chameleon it is fleshy, round, thick at the apex, glutinous, and capable of being in an instant protruded by a rapid muscular action. Salivary glands are to be met with in some serpents and lizards, and in some land and fresh-water tortoises. The gullet (œsophagus) is quite distinct from the stomach, though the latter in the serpents is only a little wider than the rest of the alimentary tube. In the turtle, the gullet is beset with large, almost horny, projections (papillæ), whose points project downwards, which are well known as distinguishing real turtle soup. In the crocodiles, the stomach is globular, and its muscular coat is very thick. This stomach reminds one of that met with in birds. The intestinal tube in most reptiles is seldom more than twice the length of the body. The boundary between the small and large intestines is often indicated by a ring-like membranous valve, and here there is to be found, in some lizards, a little blind tube (coecal tube.) The intestines end in all reptiles in a cavity (cloaca), in which are found also the opening of the urinary bladder, and those from the ovaries or seminal ducts. This cloacal opening is oval in the tortoises, but forms a transverse fissure in the serpents and most of the lizards. The liver is large in the reptiles; it is sometimes, as in the crocodiles and tortoises, very much divided. A gall bladder is always present. It consists of a single lobe in the scaled, and of two lobes in the mailed reptiles. The pancreas is constantly present, but varies in form in the different genera; and it is sometimes, as in the python, deeply lobed. The spleen is always present, but is often very small. Meckel describes it as wanting in the serpents, and Aristotle decided that the chameleon could have no spleen; but in these cases the small size of the spleen caused it to be overlooked.

In connection with the digestive system it may be mentioned that, with the exception of a few tortoises and turtles, all the reptiles feed on living animals; that their teeth not being, as we have seen, formed for the purpose of dividing the flesh of the animals on which they feed, they are obliged to swallow their prey whole, and for this purpose the upper portion of their gullet is capable of a wide extension. Digestion appears in most to be rapid, THE BLOOD SYSTEM.—The organs for the circulation of the blood and for respiration are by no means so perfect as we found them to be in mammals and birds, although the great central organ, the heart, consists as yet essentially of four chambers; yet, as we shall see, the two ventricles are often very imperfectly separate, and consequently a portion of the blood (venous) on its way to the lungs, to be there revivified, mixes with the blood from the lungs (arterial), and is sent with this latter to the different parts of the body. In the lizards, snakes, and tortoises, the heart can scarcely be said to have four chambers, for the two ventricles unite to form a single cavity. In them the venous blood returned from the system to the large right auricle is kept in some measure distinct from the arterial blood returned from the lungs, by the alternation in the time of contraction of the anterior and posterior walls of the ventricle: thus, on the contraction of the anterior portion of the ventricle, the blood is forced into the arterial side of the blood system, before the contraction of the posterior part of the same cavity commences. In the crocodiles the partition between the two ventricles is complete, but there is still a communication between the main arteries and veins.

The lungs in reptiles are very varied. In some (Hatteria), they are wonderfully simple in their structure; in others, they are more complex. They generally consist of large or small sacs, with little projections on their walls. In the crocodiles, the lung-structure is less sac-like, more condensed, neither do the lungs extend into the abdominal cavity, and there is also the rudiments of, as it were, a diaphragm; but in the snakes, the lungs extend down for a great way into the abdominal cavity, and all trace of a diaphragm is lost. In the tortoises, the lungs are broad and flat, and extend even to the pelvis. In many serpents there is only one lung present; in some there are two, but they are unequal in size. When one lung is absent, it is mostly the left lung.

The trachea (windpipe) in the mailed reptiles is somewhat more perfect than in the lizards and snakes. It sometimes has a couple of convolutions, reminding one of the trachea of some birds, before it enters the lungs. In many serpents, the trachea is provided with rings at its lower part, the upper part being formed of a thin membrane; the bronchi are in lizards short, in the tortoises somewhat long. They usually end abruptly in the lung substance, not dividing; but in the crocodiles and tortoises they extend throughout the lung, and are perforated by many openings.

The respiration of reptiles is always æreal. In the serpents and lizards the ribs act a most important part in assisting expiration. Although some of the reptiles have a larynx, yet very few of them emit a true sound. The hissing sounds given by serpents when disturbed, and the odd blowing sound now and then given by the chameleon, are due to the rapid expulsion of air through the small oblong aperture (glottis) in their larynx. Some of the geckos, however, emit a cry which may be imitated by repeating sharply the syllable "chīc-chīc."

The kidneys in this class are of very various form and magnitude, being very long in the serpents, somewhat oval in the lizards, and thick oval bodies in the tortoises. There is no urinary bladder in the snakes or crocodiles, but one is usually present in the lizards and tortoises.

THE NERVOUS SYSTEM.—The brain in reptiles is small in comparison with the spinal cord; and in this latter there is to be constantly met with that canal which we referred to as existing, in a very rudimentary condition, in the mammals, and which in the reptiles opens into one of the ventricles (the fourth) of the brain. The hemispheres of the brain are without convolutions, but are still greatly larger than the optic (eye) lobes. As we would expect, the hemispheres and the cerebellum (little brain) are larger in the crocodiles than in the lizards and snakes. The nerves from the brain correspond in great measure, in number of pairs and in origin, with those in the mammals and birds. As to the organs of special sense, that of touch seems wanting, though the tongue may perhaps serve as such in some of the snakes and lizards.

Probably that of taste is also very much in abeyance, though it is present in a degree in some of the lizards and land-tortoises.

The cavity of the nose in the reptiles has openings into the mouth or gullet, as is, indeed, the case with all lung-breathing animals. The olfactory nerve is also large; and doubtless the sense of smell is of great use in enabling the night-feeding reptiles to obtain their food.

All reptiles have eyes. In many these are small in comparison with the size of their bodies; but in some—geckos and chameleons—they are proportionately large. In some the eyeball is covered with the skin, which does not split to form eyelids. In the proteus, this skin is only very slightly transparent, and the animal is consequently very little affected by light. In the serpents and some lizards this skin becomes quite transparent, and forms a species of "watch-glass" over their eyes, behind which the tears may gather but out of which no tear can fall. In other reptiles we find not only an upper and a lower eyelid—the latter being the one that covers the eye—but a third eyelid (*membrana nictitans*), which folds transversely across the eye behind the two horizontal lids. In very many of the lizards and the tortoises there is to be found in the eyeball a ring of bony plates, which strengthens it. In most, the pupil is round; but it is an elongate slit in the crocodiles.

In the chameleon, the "watch-glass" like eyelid is perforated in the middle, just opposite the centre of the pupil, and the eyes placed at either side of the head can act independently the one of the other; indeed, squinting is quite a normal habit of reptiles.

The organ of hearing is well developed, but an external ear is wanting, only a trace of such existing in the crocodiles, where the tympanum (drum) can be concealed at pleasure. In the snakes, and in a few of the lowest forms of lizards, a tympanic cavity is wanting.

THE MUSCULAR SYSTEM.—The muscles in the reptiles are red, though often of a paler hue than in mammals and birds. Muscular irritability is great, lasting for a long time after death. The power of reproducing lost parts is here, for the first time in the Vertebrates, to be met with. Often, at the slightest touch, some lizards will part with their tails, which they soon proceed to grow again.

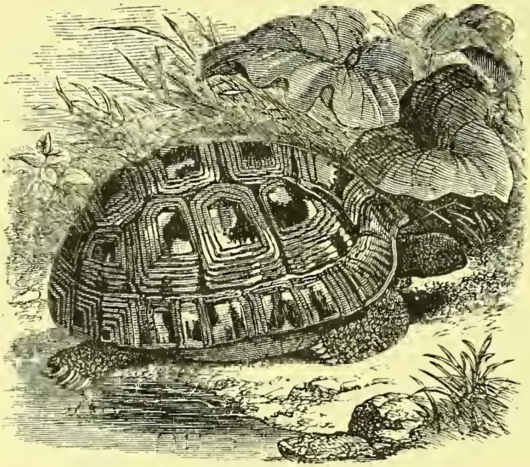
Reptiles are able to run, climb, swim, and even in some cases they can take great springs, which power in a few amounts to a kind of fluttering flight. Others, again, can only proceed by creeping. While very tenacious of life, capable of enduring great extremes of heat and cold, and of being deprived of food for long periods, they not unfrequently indulge in winter sleep (hibernation). They grow very slowly, and we have reason to believe live to an immense age.

All reptiles are oviparous—that is, as we have seen, produced from eggs, the development of which takes place outside the body of the parent. But in some the eggs are for a time retained in the egg-passages of the mother until the development of the young has proceeded to a certain degree; and in others it even proceeds so far that the young break out of the egg while still in the egg-passages (ovo-viviparous). The eggs of many of the turtles and lizards have an outer covering of a leathery consistency. In some lizards, and in tortoises, the outer covering is hard, containing carbonate of lime, and resembles in consistency the shell of birds' eggs; but in shape these eggs are generally oblong. Some lizards deposit their eggs within the bark-layers of trees; some turtles bury them to some depth in the sand; others, like the python, help to incubate them by coiling the folds of their bodies around them.

The class of the reptiles may be sub-divided as follows :—

With bony plates in skin	Order 1	Chelonia.
„ „	„ 2	Crocodilina.
With scales in skin	„ 3	Rhyncocephalina.
„	„ 4	Lacertilia.
„	„ 5	Ophidia.

ORDER I.—TORTOISES (*Chelonia*).



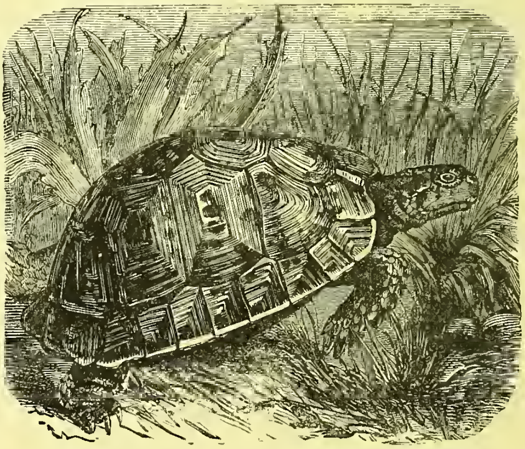
THE EUROPEAN TORTOISE (*Testudo græca*).

This order of reptiles contains the Tortoises and Turtles. Their body is enclosed, more or less, in a great bony case or double shield, the upper portion of which is more or less convex, and the lower usually flat. The former, called the carapace, is composed of the bodies of the vertebræ of the back and of the broad greatly flattened ribs, generally eight in number; externally it is covered with hard plates, either horny or bony. The latter, called the plastron, is formed of about four pairs of bony plates, usually supposed to be modifications of the breast-bone (sternum), probably also united with bone developed in the skin which covers them. Between these two will be found a series of marginal plates, perhaps dermal (skin) appendages. With these the plastron is usually firmly attached, the two thus forming a solid bony box, open at the two ends, for the animal's head and tail respectively. The horny plates of the carapace are generally arranged in three sets—a central set (dorsal), a set on either side of these (lateral), and a set surrounding the whole carapace (marginal). These plates, in one genus, yield the well-known tortoiseshell.

The drum of the ear is naked in most, but covered in some. The eyes have three eyelids. There are no teeth, but the jaws are covered with sharp-edged horny plates. There are four feet. Linnæus knew but a single genus, Testudo, and enumerates some fifteen species; now over two hundred species are known, and these may be divided into the following families:—

FAMILY I.—TESTUDINIDÆ.

This family includes the land and many fresh-water tortoises, with retractile heads. While found in both the Old World and America, they would appear to be entirely absent from Australia. Of the restricted genus Testudo, perhaps one of the best known is the common European Tortoise (*Testudo græca*). It loves sandy soil, and feeds on vegetables. It is to be found in Greece, Southern Italy, and in Sicily; it is also found in the South of France, and apparently extends to the Caspian Sea.



THE MOORISH TORTOISE (*Testudo mauritanica*).

"Among Lycian reptiles," says Professor E. Forbes, "this tortoise is the most conspicuous and abundant. The numbers of these animals straying about the plains and browsing on the fresh herbage in spring astonishes the traveller. In April they commence love-making. Before we were aware of the cause we were often surprised, when wandering among ruins and waste places, at hearing a noise, as if some invisible geologist was busily occupied close by trimming his specimens. A search in the direction of the noise discovered the hammer, in the shape of a gentleman tortoise, who, not being gifted with vocal powers, endeavoured to express the warmth of his affection by rattling his shell against her side. The loves of the tortoise are celebrated by Ælian."

Of other European species, T. mauritanica is found in the valleys of the south of the Crimea, and is sent to Paris in numbers from Algeria. T. marginata is also found in Greece.

The visitors to the Gardens of the Zoological Society may have often looked on some ponderous tortoises to be seen there (*T. elephantina*), feeding at their ease, and utterly indifferent to the observer. These are natives of the Seychelles and Comoros. Many years ago one of them was presented to the Society by Lieut.-General Sir Charles Colville, late Governor of the Mauritius. It was one of those which had been brought from the Seychelles to the Mauritius, in 1766, and was believed to have remained unchanged in size and appearance, though it had been there sixty-seven years. Of the habits of this tortoise in its native islands but little is known.

Darwin ("Voyages of the *Adventure* and *Beagle*") gives the following admirable account of the Great Tortoise of the Galapagos Islands, probably T. elephantopus, respecting which Dampier says: "The land turtles are here so numerous, that five or six hundred men might subsist on them for several months, without any other sort of provision. They are so extraordinarily large and fat, and so sweet, that no pullet eats more pleasantly."

"These animals," observes Mr. Darwin, "are found, I believe, in all the islands of the Galapagos archipelago, certainly in the greater number. They frequent, in preference, the high, damp parts, but likewise inhabit the lower and arid districts. Some individuals grow to an immense size. Mr. Lawson, an Englishman, who had, at the time of our visit, charge of the colony, told us that he had seen several so large, that it required six or eight men to lift them from the ground, and that some had afforded as much as two hundred pounds of meat. The old males are the largest, the females rarely growing to so great a size. The male can readily be distinguished from the female by the greater length of its tail.

"The tortoises which live on those islands where there is no water, or in the lower and arid parts of the other islands, chiefly feed on the succulent cactus. Those which frequent the higher and damp regions eat the leaves of various trees, a kind of berry called guayavita, which is acid and austere, and likewise a pale-green filamentous lichen, that hangs in tresses from the boughs of the trees.

"This tortoise is very fond of water, drinking large quantities, and wallowing in the mud. The larger islands alone possess springs, and these are always situated towards the central parts and at a considerable elevation. The tortoises, therefore, which frequent the lower districts, when thirsty, are obliged to travel from a long distance. Hence broad and well-beaten paths radiate off in every direction from the wells, even down to the sea-coast; and the Spaniards, by following them up, first discovered the watering-places. When I landed at Chatham Island, I could not imagine what animal travelled so methodically along the well-chosen tracks.

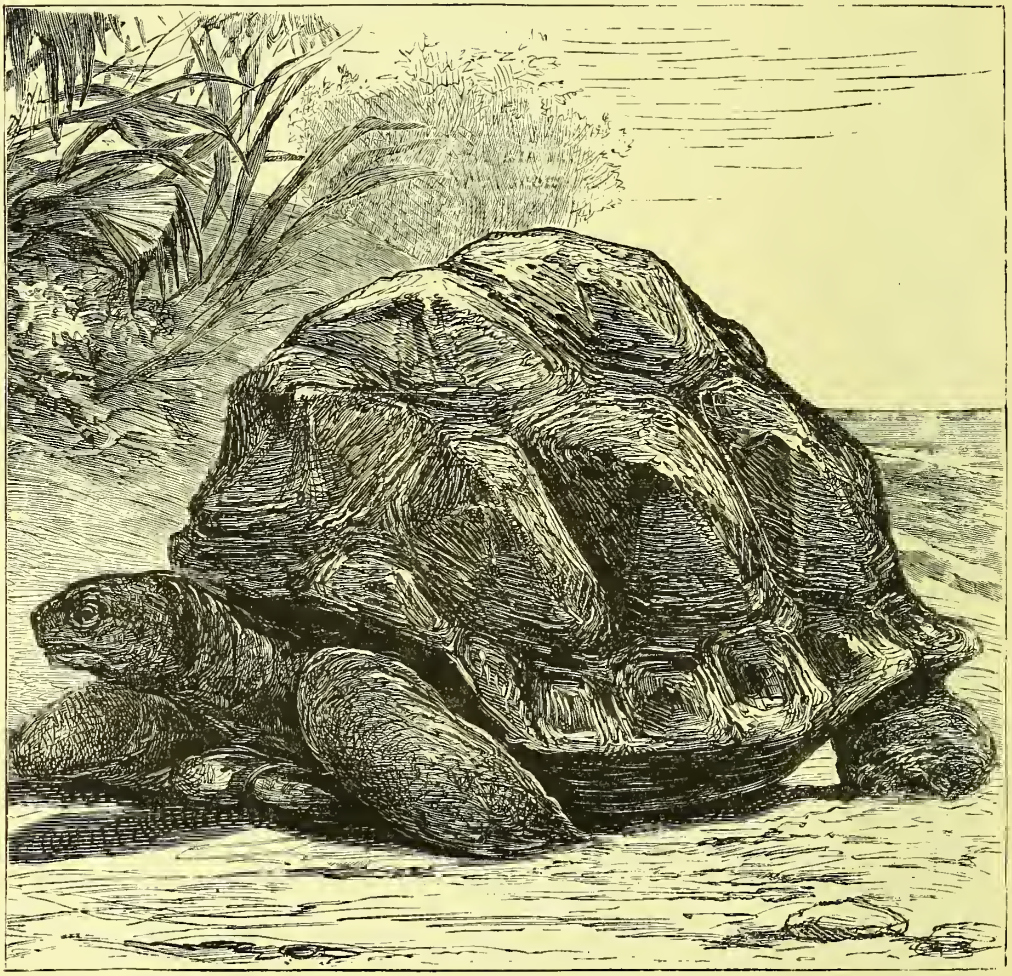
"Near the springs it was a curious spectacle to behold many of these great monsters; one set eagerly travelling onwards with outstretched necks, and another set returning after having drunk their fill.

"When the tortoise arrives at the spring, quite regardless of any spectator, it buries its head in the water, above its eyes, and greedily swallows great mouthfuls, at the rate of about ten in a minute. The inhabitants say each animal stays three or four days in the neighbourhood of the water, and then returns to the lower country; but they differed in their accounts respecting the frequency of their visits. The animal, probably, regulates them according to the nature of the food which it has consumed. It is, however, certain that tortoises can subsist even on those islands where there is no other water than what falls during the few rainy days in the year.

"The tortoises, when moving towards any definite point, travel by night and day, and arrive at their journey's end much sooner than would be expected. The inhabitants, from observations on marked individuals, consider that they can move a distance of about eight miles in two or three days. One large tortoise, which I watched, I found walked at the rate of sixty yards in ten minutes; that is, three hundred and sixty in the hour, or four miles a day, allowing also a little time to eat on the road.

"During the breeding season, when the male and female are together, the male utters a hoarse roar or bellowing, which, it is said, can be heard at a distance of more than a hundred yards. The female never uses her voice, and the male only at such times. They were at this season (October) laying their eggs. The female, where the soil is sandy, deposits them together, and covers them up with sand; but where the ground is rocky, she drops them indiscriminately in any hollow. Mr. Bynoe found seven placed in a line in a fissure. The egg is white and spherical: one which I measured was seven inches and three-eighths in circumference.

"The young, as soon as they are hatched, fall a prey in great numbers to a buzzard with the habits of the Caracara vulture. The old ones seem generally to die from accidents, as from falling down precipices: at least, several of the inhabitants told me they had never found one dead without some such apparent cause.



THE ELEPHANT TORTOISE (*Testudo elephantina*).

"The inhabitants believe that these animals are absolutely deaf; certainly they do not overhear a person walking close behind them. I was always amused, when overtaking one of these great monsters as it was quietly pacing along, to see how suddenly, the instant I paused, it would draw in its head and legs, and uttering a deep hiss, fall to the ground with a heavy sound, as if struck dead. I frequently got on their backs, and then, upon giving a few raps on the hinder part of the shell, they would rise up and walk away; but I found it very difficult to keep my balance.

"The flesh of this animal is largely employed, both fresh and salted; and a beautifully clear oil is prepared from the fat. When a tortoise is caught, the man makes a slit in the skin, near its tail, so as to see inside its body whether the fat under the dorsal plate is thick. If it is not, the animal is liberated; and is said to recover soon from this strange operation.

"In order to secure the tortoises, it is not sufficient to turn them, like turtles, for they are often able to regain their upright position." While staying in the upper district of James's Island, where a party of Spaniards were employed in catching tortoises, Mr. Darwin and his companions lived entirely on the meat of these animals. "The breastplate roasted, with the flesh attached to it," he says, "is very good, and the young tortoises make excellent soup; but otherwise, the meat, to my taste, is very indifferent."

Commander Cookson, R.N., on H.M.S. *Petrel*, visited these islands in July, 1875, and he says that "these animals are extinct on Charles Island, and only a very few individuals are supposed to survive on Chatham Island. In Hood, James, and Indefatigable Islands the numbers are so reduced that they are no longer hunted, the few left being in the most inaccessible parts of the islands; and I was assured that a search of a fortnight might not result in finding a single individual on either of these islands. Albemarle and Abingdon are the only remaining islands in which they have ever been found. In parts of Albemarle Island they are still very abundant, especially at the south-east end.

"They are still tolerably numerous near Tagus Cove. Landing a party of twenty-four men about half a mile south-east of Tagus Cove, we found in a few hours thirty tortoises: the three largest weighed respectively 241 lb., 185 lb., and 173 lb.; these, I was told, were as large as they are commonly found now.

"Tagus Cove is a favourite resort of whalers for the purpose of getting tortoises. The anchorage is perfectly secure: and the custom is for almost the entire crew to be landed until as many tortoises are secured as can be conveniently taken on board, some whalers going to sea with as many as 100.

"We found a good trail leading from the landing-place (at one of the gullies having pools of fresh water at its mouth) to the ground where the tortoises are found, a distance of about three miles; quantities of tortoise-shells, and traces of fires showed the numerous camping-grounds.

"Tortoises were never, I believe, very abundant on Abingdon Island: our searching party found four on this island. They were on the high ground; and it was a work of great labour getting them down to the boats. The distance was about four miles; but the ground was exceedingly rugged, and covered with thick brush, through which a trail had to be cut for the entire distance. The largest found on this island weighed 201 lb., and the smallest 135 lb.

"In consequence of the extent of Albemarle Island, and the inaccessibility of many parts of it, I have no doubt these animals are still very numerous on it, and are likely to be so for a long period, even at the present rate at which they are destroyed; but I have already shown the havoc made amongst them by the oil-makers. This is the cause of their being nearly extinct on James and Indefatigable Islands, where they used to be so numerous. Admiral Fitzroy found a party on James Island making oil in 1835.

"In Abingdon Island, where they are not numerous, I believe they are doomed to destruction directly the orchilla-pickers are placed on the island: for a party of sixty or eighty men will soon hunt over this small island, and discover every individual on it. The meat is highly esteemed by the inhabitants; we found it rather tough and stringy; but it makes excellent soup.

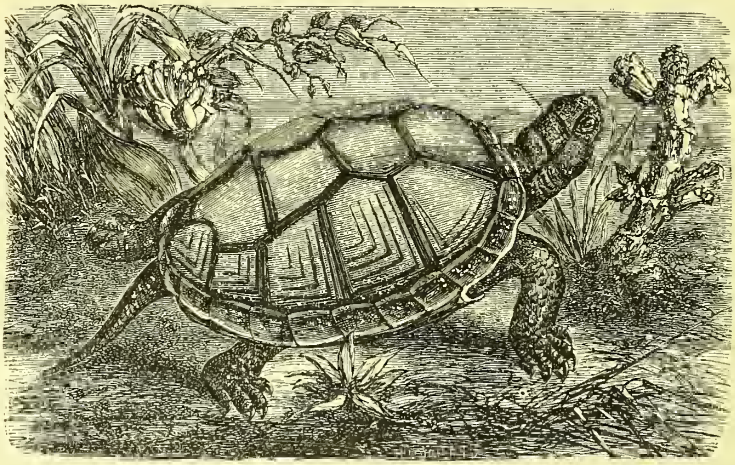
"The tameness of the birds on the island has been frequently noticed; it is certainly very remarkable, especially in Charles and Chatham Islands, which have been so long inhabited. The small birds of all kinds are so tame that they are easily knocked down with a switch. Some of the men killed numbers of doves in this manner.

"The rocks at Iguana Cove were thickly covered with the hideous black iguanas, mentioned by Admiral Fitzroy. We found them in numbers at the other places we visited, but nowhere else so numerous or so large in size. Here they were found to weigh from 20 to 22 lb., against 12 to 14 lb. from other localities."

Dr. Günther in two elaborate memoirs has fully described these immense tortoises.

The genus Emys contains nearly as many species as all the other genera of this family placed together. They are peculiarly and characteristically abundant in North America, but some species are to be met with in North Africa, and some in South and Middle Europe. Nearly all of them are aquatic, living in marshy places, small lakes, or rivers;

and they may be designated fresh-water tortoises. Their toes are not so much united as in the land-tortoises, and between the toes there is a web-like membrane. They feed on insects and fish. The European Fresh-water Tortoise (*Emys lutaria*) is found in the South of France, in many parts of Germany, in Greece, the Crimea, and to the shores of the Caspian. It passes the winter in a state of torpor, partly buried in the earth. Another species (*E. sigriz*) is said to be common on the north-west coast of Africa, and to be also found in Spain.

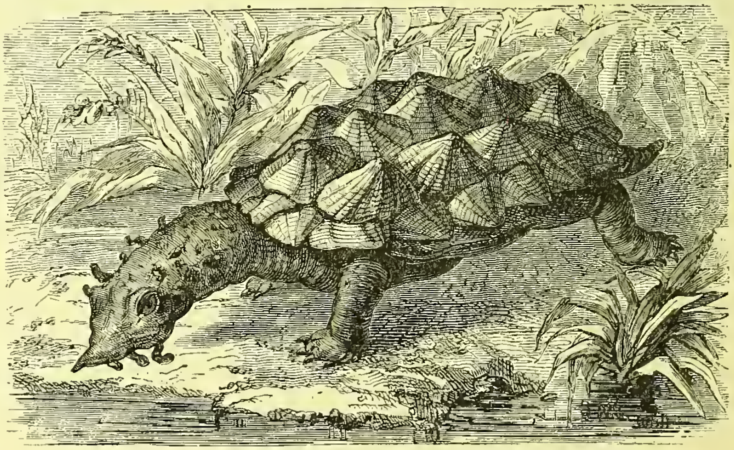

THE MUD TORTOISE (*Cistudo europæa*).

FAMILY II.—CHELYDIDÆ.

This family contains scarcely half a hundred species of fresh-water tortoises, and these have not the power of completely retracting their heads. They are to be found in South America, but a few species are to be met with in South Africa and in Australia. Their nose is often prolonged into a snout, the mouth has frequently soft lips, and the head and neck are often furnished with membranous lobes, like as if they were stuck over with sea-weeds. They feed principally upon fish. One of the best-known species is Chelys fimbriata, from South America, and of the other genera we may mention Podocnemis, Platemys (South America), Elseya (Australia), Sternotheres, and Pelomedusa (South Africa, Madagascar).

FAMILY III.—TRIONYCHIDÆ.

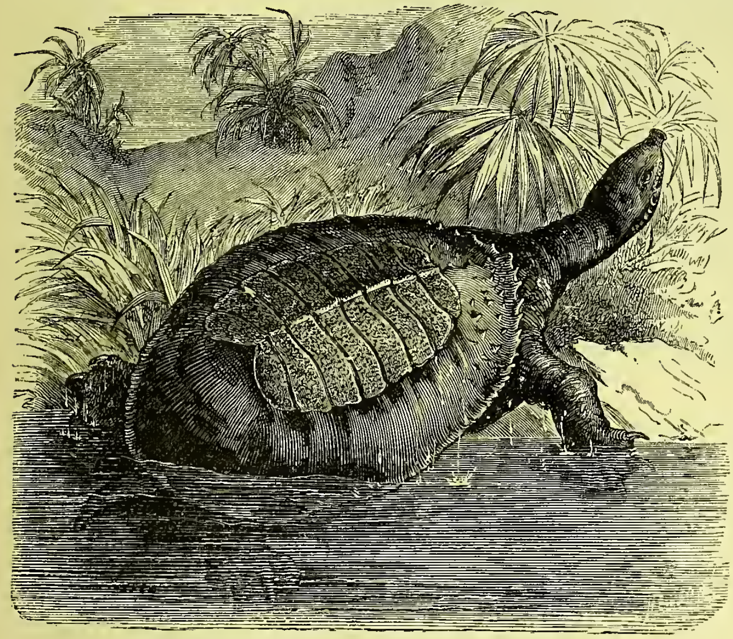
The species of this interesting family are remarkable for having a carapace more or less imperfect, whence they are often called soft tortoises. The ribs do not join together to form a solid structure, but may be seen running out to the margin like the spokes of a wheel, the interspaces being covered with a leathery skin. The neck is rather long, and neither the head nor the limbs can be withdrawn into the bony case. The jaws have fleshy lips, the toes are webbed, and three out of the five on each foot are clawed. They are aquatic, feeding principally on fish, but at times eating even reptiles and birds. The Snapping Turtle (*Trionyx ferox*), which is found in the rivers and lakes of North America, is said to destroy great numbers of small alligators, and another species found in Africa


THE BEARDED TORTOISE (*Chelys matamata*).

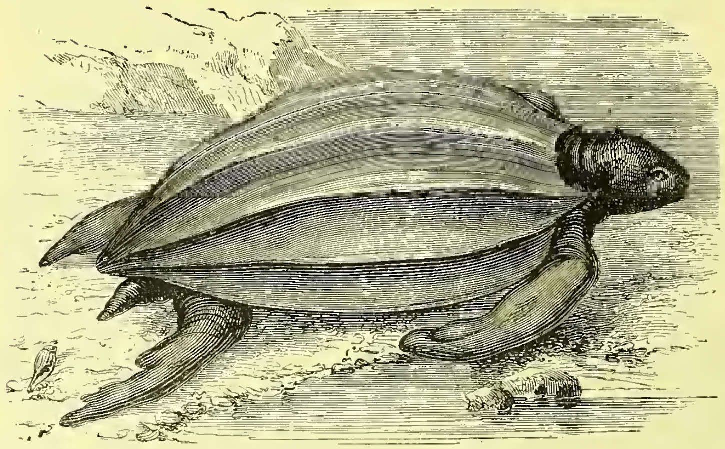
(*T. niloticus*) does the same with the young crocodiles. The principal genus, Trionyx, has been split up into as many as eight genera, with an average of two species in each. These are found in the warmer parts of America, Asia, and Africa. The species (five) of Cycloderma are peculiar to Africa, and those of Emyda are found in parts of British India and in Ceylon.

FAMILY IV.—CHELONIDÆ.

In this family we find the legs adapted for swimming, the feet being changed into flat fins, the toes being quite hid by a common skin, the front pair are a great deal larger than the posterior pair. The head and limbs are always protruded, the body only being enclosed in horny or bony case; the jaws are horny, like those of a bird of prey, and are sometimes serrated on their edges. All the species live in the seas of warm climates, and rarely approach the shores, except at the breeding season. Each species has its own period in which this important visit is performed; but it is always in the spring, or early part of the summer, and the males follow or accompany the females in their long voyage. The low, sandy shores of small desert isles, or the flat coasts of larger islands, or continents, are their usual haunts; and night is the time in which they begin their operations. The place sought is beyond the mark of the highest tides; and hence these animals have often to drag themselves to a considerable distance inland (comparatively speaking), over a long flat, sandy beach, left dry by the ebbing tide, but to be covered by its return. The following graphic account is from the pen of M. Audubon:—


THE EGYPTIAN RIVER TURTLE (*Trionyx ægyptiacus*).

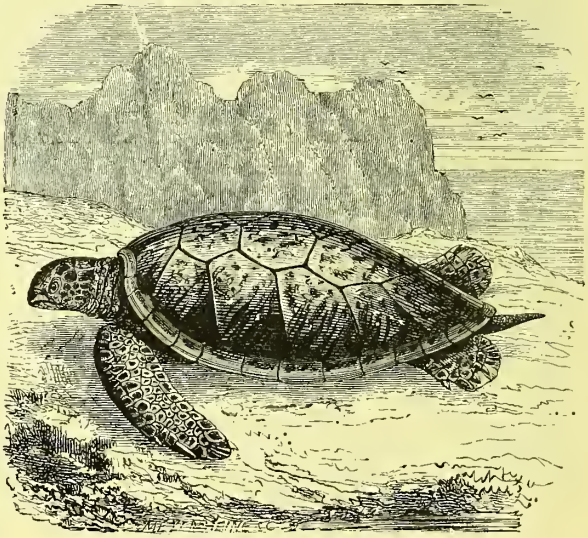
"On first nearing the shore, and mostly on fine, calm, moonlight nights, the turtle raises her head above the water, being still distant thirty or forty yards from the beach, looks around her, and attentively examines the objects on shore. Should she observe nothing likely to disturb her intended operations, she emits a loud, hissing sound, by which such of her many enemies as are unaccustomed to it are startled, and so are apt to remove to another place, although unseen by her. Should she hear any more noise, or perceive any indications of danger, she instantly sinks, and goes off to a considerable distance; but should everything be quiet, she advances slowly towards the beach, crawls over it, her head raised to the full stretch of her neck. and when she has reached a place fitted to her purpose. she gazes all around in silence. Finding all well, she proceeds to form a hole in the sand, which she effects by moving it from under her body with her hind flappers, scooping it out with so much dexterity that the sides seldom if ever fall in. The sand is raised alternately with each flapper, as with a large ladle, until it has accumulated behind her, when, supporting herself with her head and forepart on the ground, she, with a spring from each flapper, sends the sand around her, scattering it to the distance of several feet. In this manner the hole is dug to the depth of eighteen inches, or sometimes more than two feet. This labour I have seen performed in the short period of nine minutes. The eggs are then dropped one by one, and disposed in regular layers, to the number of one hundred and fifty, or sometimes nearly two hundred. The whole time spent in this part of the operation may be about twenty minutes. She now scrapes the loose sand back over the eggs, and so levels and smooths the surface that few persons on seeing the spot would imagine that anything had been done to it. This accomplished satisfactorily to her mind, she retreats to the water with all possible dispatch, leaving the hatching of the eggs to the heat of the sand."



THE LEATHERY TURTLE (*Sphargis coriacea*).

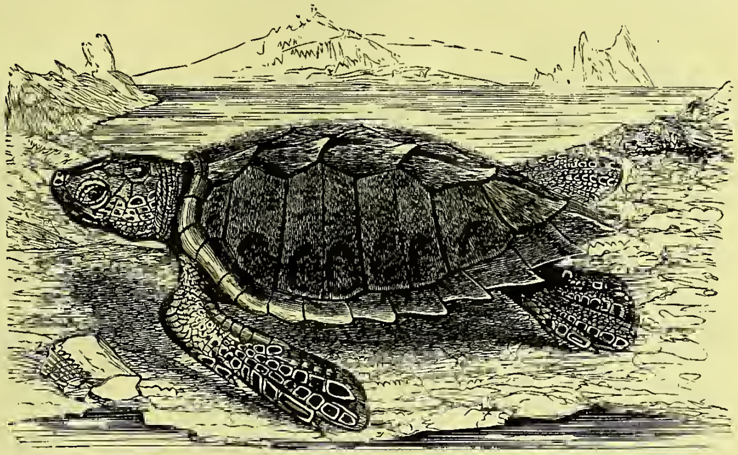
The Leathery Turtle (*Sphargis coriacea*) sometimes attains the length of eight feet. It has the back covered with a leathery skin; the claws are without nails. It is said sometimes to weigh a thousand pounds, and is found in the Mediterranean as well as in the three great oceans. It has been taken now and then on the coasts of England and France, and Lacepede supposes that the shell of this animal was employed by the Greeks in the formation of their lyres.

The species of the only other genus (Chelone) are all tropical. Of those described we must mention the following, of which the one most interesting to the gourmand, the Green Turtle (*Chelonia viridis*), is found in all warm seas, and frequently in immense numbers. It chiefly feeds on seaweeds; it grows to a length of from five to six feet, and a good specimen will weigh 500 lb. to 600 lb., but an equally important species is the one (*C. imbricata*), the horny plates of which constitute the "tortoiseshell" of commerce. It is found in the tropical seas of both hemispheres, and from the curved and pointed form of its upper bill is often called the hawk's-bill turtle. It rarely exceeds three feet in length, and it is not good for food. The finest tortoiseshell is said to come from the Indian Ocean. The fineness of its texture, its compactness, the admirable polish and the carving which it is capable of receiving, the facility with which it may be moulded, the capacity it has for having its fragments soldered together by heat and pressure—these qualities give to it its value.



THE GREEN TURTLE (*Chelonia viridis*).

"The scales of the turtle in question, when detached from the carapace, are bent in different ways; their thickness, besides, is not uniform, and often it happens that they are too thin, at least throughout a great portion of their substance. In order to straighten them, it is sufficient to steep them in boiling water for a few minutes, and then take them out, and place them between plates of metal, or smooth blocks of hard wood, leaving them to cool, great pressure being applied at the same time. They then retain the flatness desired. They are next scraped and filed, a smooth surface being obtained with as little loss as possible. When these shells, or scales, are brought to a proper thickness and size, they may then be used separately, but they are generally submitted to a still further preparation. When, for instance, they are too thin, or when they are not sufficiently long or broad, the following processes are employed. In order to obtain single plates of great size, two are soldered together, the thin part of one being laid upon the thin part of the other; or, as is sometimes done, the edges of each plate are delicately bevelled, and fitted together. In each case, they are then put between metallic plates: to these a certain degree of pressure is given, which, when the whole is plunged into boiling water, is increased; and by this mode they are so intimately joined together that the very slightest trace of their union cannot be detected.



THE LOGGERHEAD TURTLE (*Chelonia caretta*).

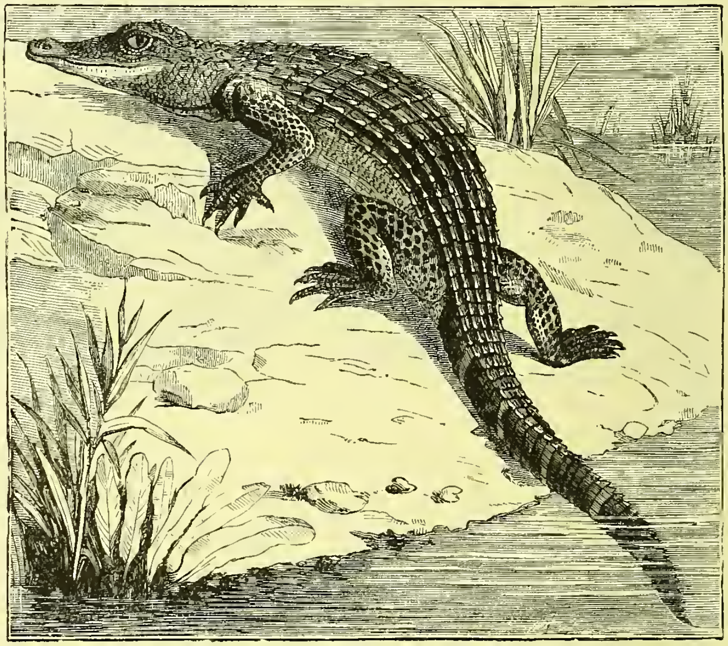
"It is almost exclusively by the means of boiling water that these effects upon tortoiseshell are obtained. The substance of the scales becomes so softened by the action of the heat that it may be acted upon like a soft mass, or a flexible and ductile paste, which, by pressure in metallic moulds, will assume every variety of form required.

"The soldering of two pieces together is effected by means of hot pincers, which, while they compress, at the same time soften the opposed edges of each piece, and amalgamate them into one. No portion of the scales is worthless; the raspings and powder produced by the file, mixed with small fragments, are put into moulds, and subjected to the action of boiling water, and thus made into plates of the desired thickness, or into various articles, which appear cut out of a solid block."

A third species, the Loggerhead Turtle (*C. caretta*), is perhaps the largest of all. It is not very uncommon in the Mediterranean. It grows to a weight of upwards of fifteen hundred pounds, and feeds chiefly on molluscs. Its flesh is not good for eating, and its horny plates are too thin to be of any use.

ORDER II.—CROCODILES (*Crocodilia*).

THE reptiles of this order have teeth always present in their jawbones, and these are received into sockets. The body is more or less covered with large bony plates (scales), which are sometimes rough (tuberculate) and sometimes keeled (carinate). Their legs are always well developed; the toes are distinct and are frequently united by webs. The head is sometimes very long, and the gape of the jaws wide. From the manner in which the lower jaw is attached to the skull, it appears as if both jaws moved in the act of opening the mouth, but in reality only the lower jaw is movable. The nostrils are situated quite at the extremity of the snout. The external ear can be closed at pleasure. The tongue is large and fleshy, but these reptiles are perfectly tongue-tied—that is, the tongue is immovably attached to the bottom of the mouth; hence the reason why the ancients thought the crocodiles had no tongues. The eggs are laid in warm, sandy places, but the young are taken no great care of by their parents. They are very numerous in the warmer rivers of America, Asia, Africa, and Northern Australia. There are about twenty-five species, which can be placed in the following families:—



THE ALLIGATOR (*Alligator mississipensis*).

FAMILY V.—ALLIGATORIDÆ.

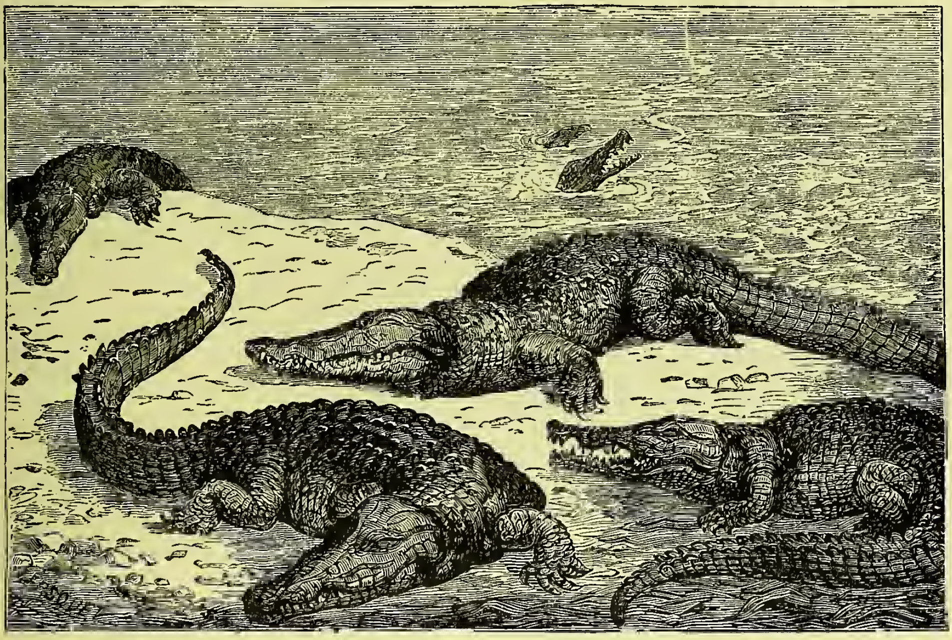
In the species belonging to this family the upper jaw is broad and flat in front (obtuse), and its margin extends over the teeth of the lower jaw. The points of the fourth tooth of the lower jaw, and the canines on each side, fit into pits on the upper jaw; the hind feet are never completely webbed. There are about ten species known, all of which are to met with in America. Perhaps the best-known species is the Mississippi Alligator (*Alligator mississipensis*); it is still common in the Southern States. It is often to be met with of the length of fifteen to sixteen feet, and specimens have been measured in Florida upwards of twenty-two feet long. Dr. Holbrook says that at the approach of winter they bury themselves in the holes in the banks of the rivers in which they live, and pass the cold season in a state of torpidity. Catesby tells us that in the breeding-season they make a hideous bellowing sound. Alligator is said to be a corruption of the Portuguese *lagarto.* By some Europeans they are called Kaaiman, or Caiman, but this latter name is often applied to species of crocodile. Of other species we may mention A. sclerops, A. palbebrosus, and A. trigonatus.

FAMILY VI.—CROCODILIDÆ.

In the species of this family the canine teeth fit into notches. The head gradually gets narrowed towards the snout. There are twelve species, which are to be found inhabiting the rivers of Africa, Southern Asia, Australia, and America. Perhaps the oldest known is the Crocodile of the Nile (*Crocodilus niloticus*). It is now only to be met with in this river at its upper portions, but it is also to be found in other parts of Africa. It sometimes grows to a length of from twenty to thirty feet.

According to Herodotus, crocodiles were sacred with some of the Egyptians, but not so with others, who treated them as enemies. He tells us that those who dwell about Thebes, and the Lake Mœris, look on them as very sacred; and they each train up a crocodile, which is rendered quite tame. Into the ears of these crocodiles they put crystal and gold earrings, and adorn their fore-paws with bracelets. They give them appointed and sacred food, treating them as well as possible while alive, and when dead they embalm and bury them in the sacred vaults. But the people who dwell about the city Elephantine eat them, not considering them sacred.

"The crocodile," continues the historian, "is blind in the water, but very quick-sighted on land; and because it lives for the most part in the water, its mouth is filled with leeches. All other birds and beasts avoid him, but he is at peace with the trochilus, because he receives benefit from that bird; for when the crocodile gets out of the water on land, and then opens its jaws, which it does most commonly towards the west, the trochilus enters its mouth and swallows the leeches. The crocodile is so well pleased with this service, that it never hurts the trochilus."

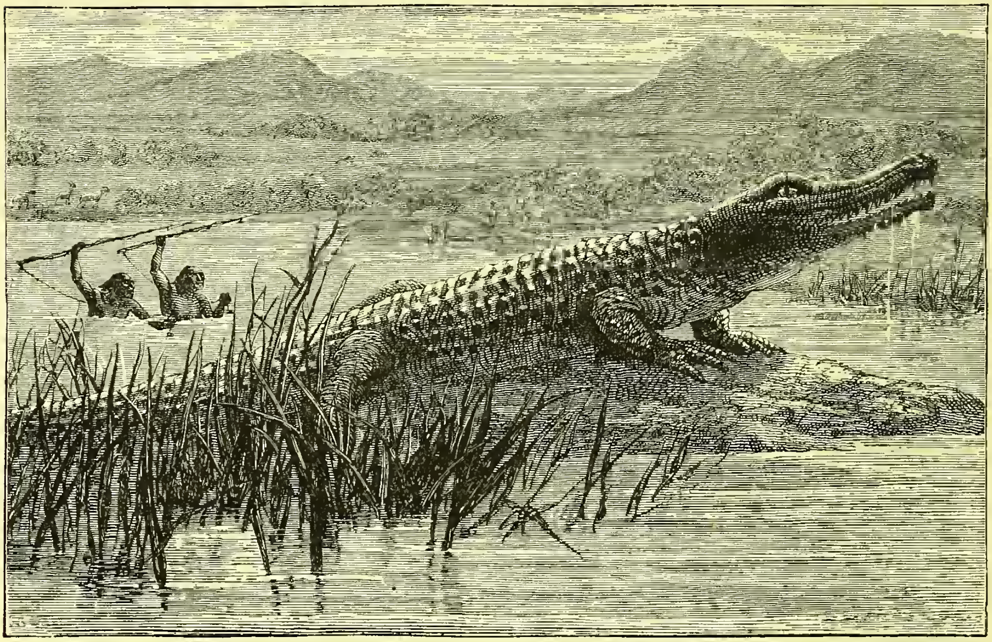


CROCODILES OF THE NILE (*Crocodilus niloticus*).

Strabo tells a strange story of a crocodile he saw when he visited Egypt, about four hundred years after Herodotus was there. "In this district they honour the crocodile very much, and they have a sacred one, which lives by itself in the lake, and is quite tame to the priests. He is called Suchos, and is fed with bread and meat and wine, which he gets from strangers who come to see him. Our host, who was a person of importance in the place, accompanied us to the lake, taking with him from table a small cake, some roasted meat, and a little cup full of some sweet liquor. We found the crocodile lying on the margin of the lake. The priests went up to him, and while some opened his mouth, another crammed into it first the cake, then the meat, and last of all poured the drink down his throat. The crocodile, after this treat, jumped into the lake, and swam over to the other side." Souc, or Souchis, according to M. Champollion, indicates the Egyptian name of Saturn; and Suchos, most probably, was the proper name of the individual that Strabo saw at Arsinoe. Thus, Apis was the sacred bull of Memphis; that of Heliopolis was Mnevis. But, however this may be, there can be no doubt that the animal was tamed by the ancients. Plutarch relates how the crocodile can be made obedient to the human voice and hand, opening its mouth, and suffering its feet to be cleaned with a towel.

The Crocodile of Jamaica (*C. acutus*) is, according to Mr. Gosse, able to emit sounds which resemble the barks of a dog, and the voice of the young is like the whining of a puppy; he also thinks that the females do protect their young, though the males will devour them. The Lozenge-scaled Crocodile (*C. rhombifer*) is found in Cuba.

C. cataphractus is an inhabitant of the flat countries on the west coast of Africa from Senegal to the Gaboon, and has also apparently been met with in Central Africa.



AFRICAN NATIVES CROCODILE HUNTING.

C. porosus is found on the north coast of Australia, at Borneo, Ceylon, Bengal, and China.

FAMILY VII.—GAVIALIDÆ.

There are but three species belonging to this family. They have all very long snouts, with sometimes a hundred teeth in their jaws. The nostrils are placed in protuberances at the end of the snout, and the hind feet are fully webbed.

The oldest known species, the Gavial (*Gavialis gangeticus*), is to the Ganges what the crocodile is to the Nile. It attains to the size of more than twenty feet, and feeds principally on fish. The front teeth are the largest, and the canines fit into notches of the upper jaw.

The Australian Gavial (*Tomistoma schlegelii*) has a smaller number of teeth, and a more conical snout.

ORDER III.—RHYNCOCEPHALIA.

This order has been recently established by Dr. Günther for a very remarkable reptile, of which we find the first mention in the diary of Mr. Anderson, the companion of Captain Cook, to whom "a monstrous animal of the lizard kind" was described by some New Zealand boys, who joined Captain Cook on his third voyage while he was in Queen Charlotte's Sound.

FAMILY VIII.—HATTERIDÆ.

Dr. Dieffenbach thus describes the only form known:—"We had been apprised of the existence of a large lizard, which the natives called Tuatera, or Narara, with a general name, and of which they were much afraid. But although looking for it at the places where it was said to be found, and offering great rewards for a specimen, it was only a few days before my departare from New Zealand that I obtained one, which had been caught at a small rocky islet called Karxwa, which is about two miles from the coast, in the Bay of Plenty. From all I could gather about this Tuatera, it appears that it was formerly common in the islands, living in holes, often in sandhills near the sea-shore, and the natives killed it for food. Owing to this latter cause, and no doubt also to the introduction of pigs, it is now very scarce; and many even of the older residents of the island have never seen it. The specimen from which the description is taken I had alive, and kept it for some time in captivity. It was extremely sluggish, and could be handled without any attempt at resistance or biting."

This very specimen was presented to the British Museum, where it still is; and it was named and described by Dr. Gray in 1842 as Hatteria punctata. It is still very rare in collections, and Dr. Günther fears that it may soon be enumerated among the forms of animal life which have become extinct within the memory of man.

There are anatomical peculiarities in this lizard, which forbid its being placed in the same order with either the true lizards or the crocodiles. It is only found in New Zealand; is now nearly, if not quite, extinct on the main island; and is found but rarely on some of the small islands near the north-east coast. It is also remarkable that this unique form should occur in a part of the globe noted for the feeble development of its recent reptilian life.

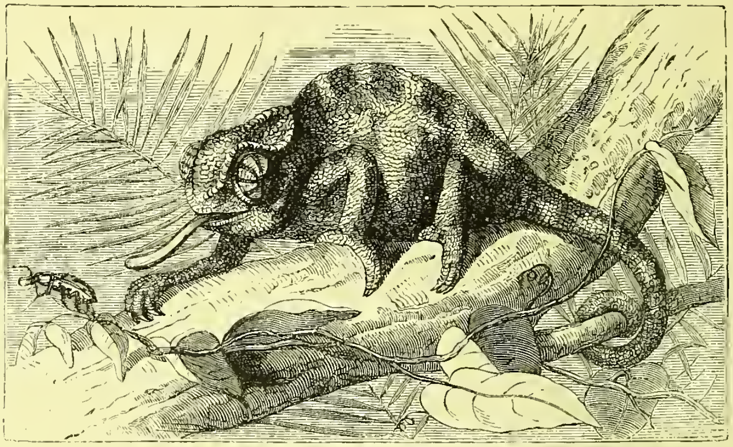
ORDER IV.—LIZARDS (*Lacertilia*).

This is an immense order, containing nearly 1,300 species, associating as we do here with the lizards the species of *Amphisbæna*. It is not easy to give a simple account, devoid of technicalities, of this immense order. In all of them the anal cleft is transverse, and so differs from that in the first two orders. There are some parts of the brain capsule never completely bony, and the branches (rami) of the lower jaw are not united by ligament, but by suture; thus their motion is limited. Their teeth are simple, and never inserted into sockets. The tongue in some is long, slender, horny, bifid, and inclosed in a sheath, from which it can be protruded at pleasure, and this even when the jaws are closed, as there is a notch left in these for this purpose. In others, the tongue is thick and fleshy, attached to the back of the mouth, without a sheath, and cannot be protruded unless when the mouth is opened; and some have divided the order into two sub-orders on this account. The eyes have generally distinct eyelids; and the ear is generally visible externally. As a rule, they have four well-developed legs; but in some no trace of these members is to be found, and such forms seem to point to the affinity of this order with the next—that of the Snakes. We follow an excellent guide (Dr. Günther) in dividing this order into the following families:—

FAMILY IX.—CHAMÆLEONIDÆ.

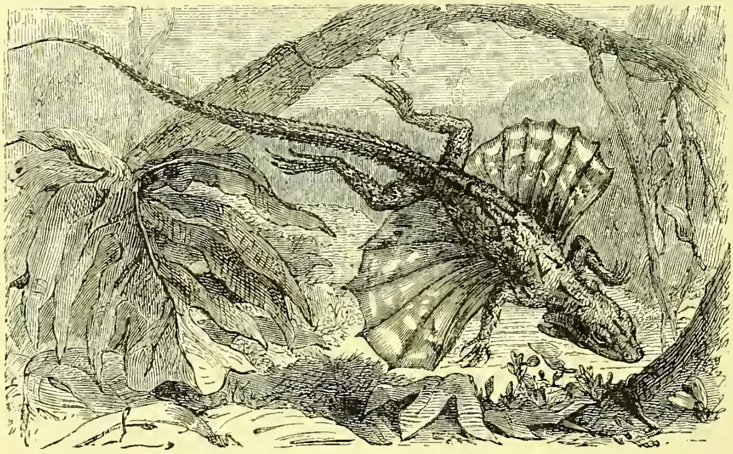
These strange, weird-like forms are almost confined to the African continent, only the Common Chameleon (*Chamæleon vulgaris*) being found to extend as far east as parts of Central Asia and Ceylon, and as far north as Spain. About thirty species are known. They form a most natural family. Some of them have, and some of them want, horns: in all the tail is prehensile. Dr. Gray makes fourteen genera; for our purposes, one genus will suffice. No less than nine species are peculiar to the island of Madagascar, and

Bourbon and the Seychelles have each their own species. They are all insectivorous, have a slow and awkward manner of moving, and have a remarkable power of changing the colour of their skin—a phenomenon partly dependent on the amount of light to which they are exposed, and partly on excitement caused by fear or anger.



THE CHAMELEON (*Chamæleon vulgaris*).

The head of these animals is very large; and from the shortness of their neck, it seems as if set upon the shoulders. The upper part often presents an elevated central crest; and a ridged arch is over each orbit to the muzzle. The internal organ of hearing is entirely concealed. The mouth is very wide; the teeth are sharp, small, and three-lobed. The whole of the ball of each eye, except just over the pupil, is covered with skin, and forms a single circular eyelid, with a central orifice. The furrow between the ball of the eye and the edge of the orbit is very deep; and the eyelid, closely attached to the ball, moves as it moves. As each eye has an independent power of motion, the axis of one eye may be seen directed upwards or backwards, while that of the other is in a contrary direction, giving to the creature a strange and most ludicrous appearance. The chameleon was once said to live on air; but insects form its food. For their seizure its tongue is especially adapted. When fully protruded, it reaches to a distance at least equal to the chameleon's body; and is launched forth and retracted with equal rapidity. An insect on a leaf at an apparently hopeless distance, or a drop of water on a twig, is gone so instantaneously, that the spectator is astonished. "I never knew," said an acute observer, "a chameleon I long kept miss his aim but once, and then the fly was *the other side of the glass.*"

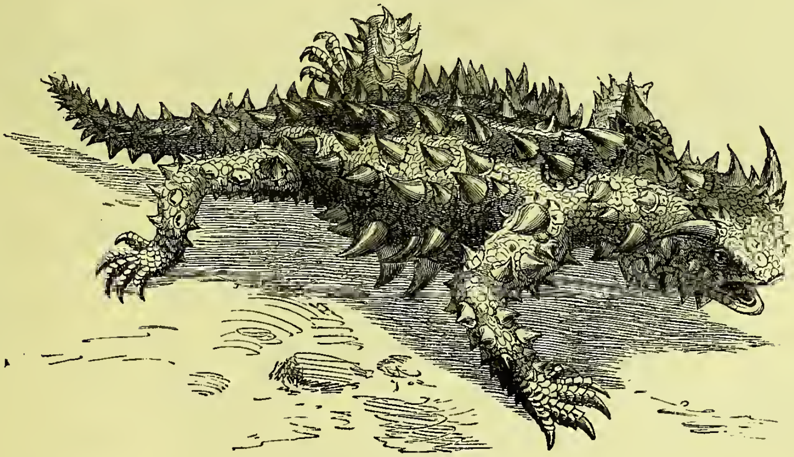


THE FLYING DRAGON (*Draco volans*).

Chameleons live in the trees, seldom coming down to the ground, except the females, who deposit their eggs in a hollow of the earth, covering them over. They are then easily caught, and this will probably account for female specimens being much more common in museums than males.

FAMILY X.—AGAMIDÆ.

This family contains the beautiful flying lizards, or "dragons," as they are often called, and numbers about 160 species. None of them are found in America; but they are to be met with all over the warmer portions of the Old World—from Greece and Southern Russia away to the Asiatic deserts, from North Africa to the Cape of Good Hope. Many of them are found in Australia, and Madagascar has its own peculiar forms. The Flying Dragons of old writers were fabulous forms, and yet not a bit more wonderful than the real Flying Dragon of the East Indies (*Draco volans*). Five or six of its ribs are very much prolonged, and these are covered over and connected with expansible folds of skin, serving as a sort of wing on either side of the body. Supported by these, they can take great jumps from branch to branch; while by means of their well-developed limbs they can run very quickly. Dr. Cantor says:—"The transcendent beauty of their colours baffles description. They have all long tails, and these are probably of use to them in their locomotion, for they are not fragile, as in many other lizard forms. Some of them, and these the brightest coloured, live in trees; others, of duller hues, inhabit rocks or sandy plains. Nearly all are insectivorous; but some feed on leaves, fruits, and seeds. Many of them possess curious skinny appendages, which form flaps about the head and neck, and which can be erected or spread out when the animal is excited. The geographical distribution of the genus Japalura is strange. There are three species—one, the Variegated Japalure (*Japalura variegata*), is a native of Sikkim; a second, Swinhoe's Japalure (*J. swinhoensis*), is found in Formosa; and the third (*J. polygonata*) is to be met with in the Loochoo Islands. No species of the genus Draco occurs in Ceylon. Stellio vulgaris is found in Greece; is not uncommon in Egypt, where, Cuvier tells us, it is held in horror by the Mahometans, because, as they say, it insults them by bowing its head in imitation of their motions when engaged in prayer. A wonderfully singular form is not uncommon in Australia, and from its extremely ferocious aspect, it has been called the Horrid Moloch (*Moloch horridus*) by Dr. Gray. No less than ten species of the genus Phrynocephalus are found in Tartary, Mongolia, Persia, and Afghanistan.

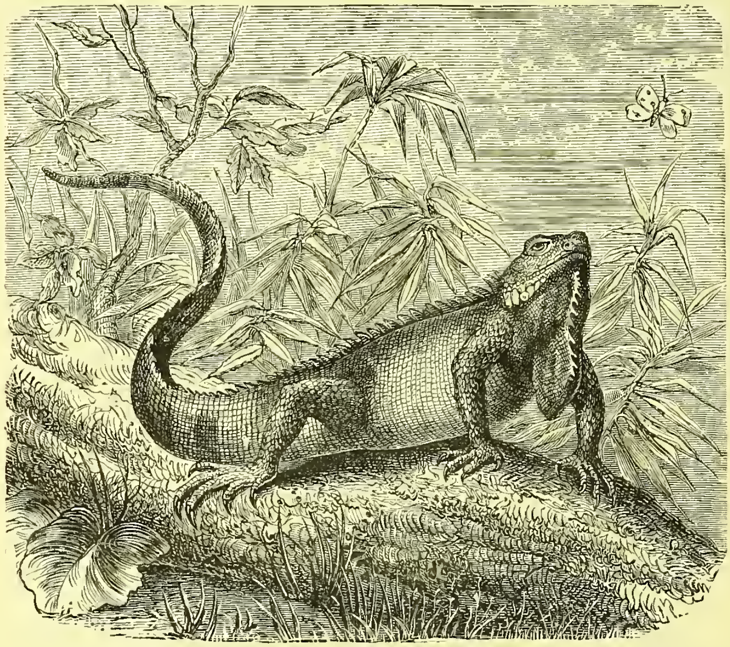


THE HORRID MOLOCH (*Moloch horridus*).

FAMILY XI.—IGUANIDÆ.

This is another large family, containing about 56 genera and some 240 species. The species can be distinguished from those of the preceding family by having a deep furrow in their jaw-bones, and the often curiously flattened and serrated teeth are attached to the inner surface of the jaw-bones. In the Agamidæ, the teeth grow upon the very edge of the jaw. In addition, all the species of this family are found either in America, or in the American islands—from Patagonia to British Columbia and Kansas. Possibly the group extends to the Fiji Islands, and thus on to Australia. The Common Iguana (*Iguana tuberculata*) sometimes attains a length of from four to five feet. It is found very generally throughout the warmer regions of South America. In Brazil, it is called senembi, and its flesh and eggs are esteemed as articles of food.

Catesby informs us that many of the Bahama Islands abound with these animals, which "nestle in hollow rocks and trees; their eggs have not a hard shell, like those of alligators, but a skin only, like those of a turtle, and are esteemed good food. They lay a great number of eggs at a time in the earth, which are hatched by the sun's heat. The iguanas furnish a great part of the subsistence of the inhabitants of the Bahama Islands, for which purpose they visit many of the remote kayes and islands, in their sloops to catch them, which they do by dogs trained up for that purpose, and which are so dexterous as not often to kill them. If they do so, however, the iguanas serve only for present use; if otherwise, they sew up their mouths to prevent their biting, and put them into the hold of their sloop, until they have obtained a sufficient number, which they either carry alive for sale to Carolina, or salt and barrel up for the use of their families at home. These iguanas feed wholly on vegetables and fruit, especially on a particular kind of fungus growing at the roots of trees, and on the fruits of the different kinds of ananas. Their flesh is easy of digestion, delicate, and well-tasted; they are sometimes roasted, but the more common way is to boil them, taking out the fat, which is melted, and clarified, and put into a dish, into which they dip the flesh of the iguana as they eat it. Though not amphibious, they are said to keep under water above an hour. They cannot run fast, their holes being a greater security to them than their heels. They are so impatient of cold, that they rarely appear out of their holes but when the sun shines."


THE COMMON IGUANA (*Iguana tuberculata*).

Brown, in his "Natural History of Jamaica," says the Great Iguana (*Cyclura lophoma?*) "lives a very considerable time without food, and changes its colour with the weather, or the native moisture of its place of residence. I have kept," he adds, "a grown iguana about the house for more than two months. It was every fierce and ill-natured at the beginning, but after some days it grew more tame, and would, at length, pass the greatest part of the day upon the bed or couch, but always went out at night. The flesh of this creature is liked by many people, and frequently served up in fricassees at their tables, in which state it is often preferred to the best fowls. This iguana may be easily tamed while young, and is both a harmless and beautiful creature in that state."

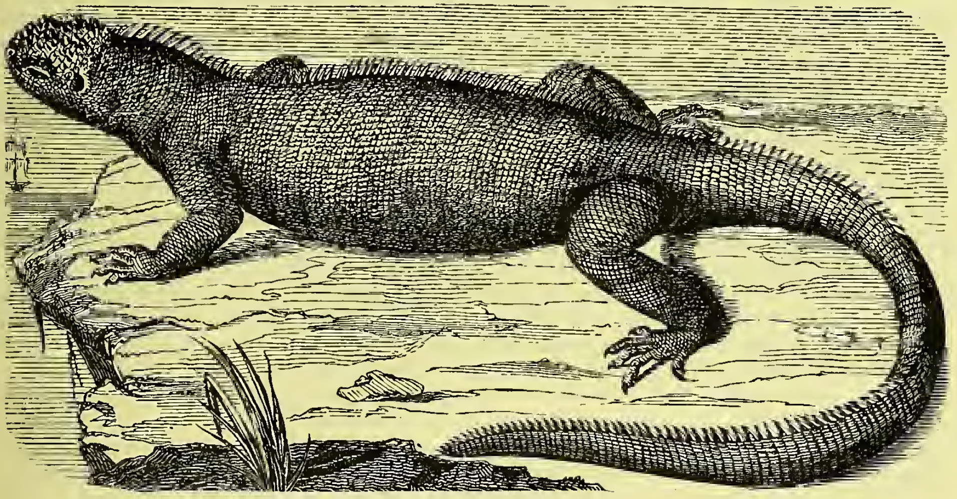
Another species, the Frilled Lizard (*Chlamydosaurus kingii*), is a native of New Holland. It has an expanse of skin, in the form of two large discs, which form a kind of frill to the sides of the neck and throat; the edge of it is serrated, and the whole covered by small, keeled scales. The head is short, and somewhat pyramidal; and the tail is long. In general, the colour is yellow, with markings of a lighter tint, bordered with brown on the back. The folded frill, which has been compared to Queen Elizabeth's ruffles, is elevated when the lizard is excited.

Mr. Darwin thus describes the habits of two most interesting forms. One—the Crested Iguana (*Amblyrhynchus cristatus*)—"is extremely common in all the islands of the

Galapagos archipelago. It lives exclusively on the rocky beaches, and is never found—at least, I never saw one—even ten yards on shore. It is a hideous-looking creature, of a dirty black colour, stupid and sluggish in its movements. The usual length of a full-grown one is about a yard, but there are some even four feet long. I have seen a large one which weighed twenty pounds.

"On the island of Albemarle they seem to grow to a greater size than on any other. These lizards were occasionally seen some hundred yards from the shore, swimming about; and Captain Collnett, in his 'Voyage,' says they go out to sea in shoals to fish. With respect to the object, I believe he is mistaken; but the fact, stated on such good authority, cannot be doubted.

"When in the water, the animal swims with perfect ease and quickness, by a serpentine movement of its body, and flattened tail; the legs, during this time, being motionless, and closely collapsed on its sides. A seaman on board sank one, with a heavy weight attached to it, thinking thus to kill it directly; but when, an hour afterwards, he drew up the line, the lizard was quite active. Their limbs and strong claws are admirably adapted for crawling over the rugged and fissured masses of lava, which everywhere form the coast. In such situations a group of six or seven of these hideous reptiles may oftentimes be seen on the black rocks, a few feet above the surf, basking in the sun, with outstretched legs.


THE IGUANA (*Amblyrhynchus subcristatus*).

"I opened the stomach of several, and in each case found it largely distended with minced sea-weed, of that kind which grows in thin foliaceous expansions, of a bright green or dull red colour. I have not observed this sea-weed in any quantity on the tidal rocks, and I have reason to believe it grows at the bottom of the sea, at some little distance from the coast. If such is the case, the object of these animals going out to sea is explained. The stomach contained nothing but the sea-weed. Mr. Bynoe, however, found a piece of a crab in one; but this might have got in accidentally, in the same manner as I have seen a caterpillar, in the midst of some lichen, in the paunch of a tortoise. The intestines were large, as in other herbivorous animals.

"The nature of this lizard's food, as well as the structure of its tail, and the certain fact of its having been seen voluntarily swimming out at sea, absolutely prove its aquatic habits; yet there is, in this respect, one strange anomaly, that, when frightened, it will not enter the water.

"From this cause it is easy to drive these lizards down to any little point overhanging the sea, where they will sooner allow a person to catch hold of their tail than jump into the water. They do not seem to have any notion of biting; but when much frightened, they squirt a drop of fluid from each nostril.

"One day I carried one to a deep pool left by the retiring tide, and threw it in several times, as far as I was able. It invariably returned in a direct line to where I stood. It swam near the bottom, with a very graceful and rapid movement, and occasionally aided itself, over the uneven ground, with its feet. As soon as it arrived near the margin, it either tried to conceal itself in the tufts of sea-weed, or entered some crevice. As soon as it thought the danger was past, it crawled out on the dry rocks, and shuffled away as quickly as it could. I several times caught this same lizard, by driving it down to a point; and though possessed of such perfect powers of diving and swimming, nothing would induce it to enter the water; and, as often as I threw it in, it returned in the manner above described.

"Perhaps this singular piece of apparent stupidity may be accounted for by this circumstance—that this reptile has no enemy whatever on shore: whereas, at sea, it must often fall a prey to the numerous sharks. Hence, probably, urged by a fixed and hereditary instinct that the shore is its place of safety, whatever the emergency may be, it there takes refuge.

"During our visit in October, I saw extremely few small individuals of this species, and none, I should think, under a year old. From this circumstance, it seems probable that the breeding season had not commenced. I asked several of the inhabitants if they knew where it laid its eggs; they said that though well acquainted with the eggs of the other kind (namely, of the following species) they had not the least knowledge on their part of the history of this aquatic kind—a fact, considering how common an animal this lizard is, not a little extraordinary."

The second species (*Amblyrhynchus subcristatus*), unlike the last, is a land lizard. "It is confined to the central islands of the archipelago, namely, to Albemarle, Barrington, and Indefatigable. To the southward, in Charles', Hood, and Chatham Islands, and to the northward, in Tower's, Bindloe's, and Abington, I neither saw nor heard of any. In the central islands, they inhabit both the higher and damp, as well as the lower and sterile parts; but in the latter, they are much the most numerous. I cannot give a more forcible proof of their numbers than by stating that when we were left at James's Island, we could not, for some time, find a spot free from their burrows on which to pitch our tent.

"These lizards, like their brothers, the sea kind, are ugly animals; and from their low facial angle, have a singularly stupid appearance. In size, perhaps, they are a little inferior to the latter, but several of them weighed between ten and fifteen pounds each. The colour of their belly, front legs, and head, excepting the crown, which is nearly white, is a dirty yellowish orange. The back is brownish red, which in the younger specimens is darker. In their movements, they are lazy and half-torpid. When not frightened, they slowly crawl along, with their tails and bellies dragging on the ground. They often stop, and doze for a minute, with closed eyes and hind legs spread out on the parched soil. They inhabit burrows, which they sometimes excavate between fragments of lava, but more generally on level patches of the soft volcanic sandstone. The holes do not appear to be very deep, and they enter the ground at a small angle; so that, when walking over these lizard-warrens, the soil is constantly giving way, much to the annoyance of the tired walker.

"The animal, when excavating its burrow, alternately works the opposite sides of its body. One front leg, for a short time, scratches up the soil, and throws it towards the hind foot, which is well placed, so as to heave it beyond the mouth of the hole. This side of the body being tired, the other takes up the task; and so on alternately. I watched one for a long time, till half its body was buried; I then walked up, and pulled it by the tail; at this, it was greatly astonished, and soon shuffled up to see what was the matter, and then stared me in the face, as much as to say, 'What made you pull my tail?' They feed by day, and do not wander far from their burrows; and if frightened, they rush to them with a most awkward gait. Except when running downhill, they cannot move very fast; which appears chiefly owing to the lateral position of their legs. They are not at all timorous: when attentively watching any one, they curl their tails; and, raising themselves on their front legs, nod their heads vertically with a quick movement, and try to look very fierce; but, in reality, they are not at all so: if one just stamps the ground, down go their tails, and off they shuffle as quickly as they can. I have frequently observed small muscivorous (fly-eating) lizards, when watching anything, nod their heads precisely in the same manner; but I do not at all know for what purpose. If this Amblyrhynchus is held, and plagued with a stick, it will bite very severely; but I caught many by the tail. and they never tried to bite me. If two are placed on the ground, and held together, they will fight and bite each other till blood is drawn.

"The individuals (and they are the greater number) which inhabit the lower country can scarcely taste a drop of water throughout the year; but they consume much of the succulent cactus, the branches of which are occasionally broken off by the wind. I have sometimes thrown a piece to two or three together, and it was amusing enough to see each trying to seize and carry it away in its mouth, like so many hungry dogs with a bone. They eat very deliberately, but do not chew their food. The little birds are aware how harmless these creatures are: I have seen one of the thick-billed finches picking at one end of a piece of cactus (which is in request among all the animals of the lower region), whilst a lizard was eating at the other; and afterwards the little bird, with the utmost indifference, hopped on the back of the reptile.

"I opened the stomachs of several, and found them full of vegetable fibres, and leaves of different trees, especially of a species of acacia. In the upper region, they chiefly live on the acid and astringent berries of the guayavita, under which trees I have seen these lizards and the huge tortoises feeding together. To obtain the acacia leaves, they crawl up the low, stunted trees; and it is not uncommon to see one, or a pair, quietly browsing, whilst seated on a branch several feet above the ground.

"The meat of these animals, when cooked, is white; and by those whose stomachs rise above all prejudices, it is relished as very good food. Humboldt has remarked, that in intertropical South America all lizards which inhabit dry regions are esteemed delicacies for the table. The inhabitants say, that those tenanting the damp regions drink water; but that the others do not travel up for it from the sterile country, like the tortoises."

The eggs, which are numerous, large, and oval, are deposited by these lizards in their burrows; the inhabitants of the islands esteem them as food.

The last species we can refer to is one found in Jamaica. "The first time I met with," writes Mr. Gosse, "that fine Iguaniform Lizard (*Dactyloa edwardsii*) called Venus by the negroes, and sometimes Green Guana, was on the high grounds of this island, and though I afterwards found it in lower situations, as on the moderate elevations of the St. Elizabeth's Hills, and even in the pimento groves of Mount Edgecumbe that border the sea-shore, it seems rather to affect the higher mountain woods. The mode in which I formed an acquaintance with the species may be worthy of being related. One day in February, having ascended the ridge with a companion, my attention was arrested by a lizard about a foot long, and of a lively green colour, on the trunk of a small tree, head downwards, intently watching our motions as we stood near. My young friend suggested the possibility of capturing it by slipping a noose over its head, while its attention was engaged by whistling. I laughingly proceeded to try the spell, and having made a noose of small twine, which I tied to the end of a switch, I gently walked towards him, whistling a lively tune. To my astonishment, he allowed me to slip the noose over his head, merely glancing his bright eye at the string as it passed. I jerked the switch, the music ceased, and the green-coated forester was sprawling in the air, dangling, greatly to his annoyance, at the end of my string. He was very savage, biting at everything near. Presently his colour began to change from green to blackish, till it was of a uniform bluish black, with darker bands on the body, and a brownish-black on the tail; the only trace of green was just around the eyes. I carefully secured him without injury, and brought him home in the collecting-basket, into which I had no sooner put him, than he fiercely seized a piece of linen in his teeth, and would not let it go for several hours. I transferred him to a wired cage, linen and all, and at length he suddenly let go his hold, and flew wildly about the cage, biting at anything presented to him. At night I observed him vividly green, as at first, a token, as I presumed, that he had in some measure, recovered his equanimity.

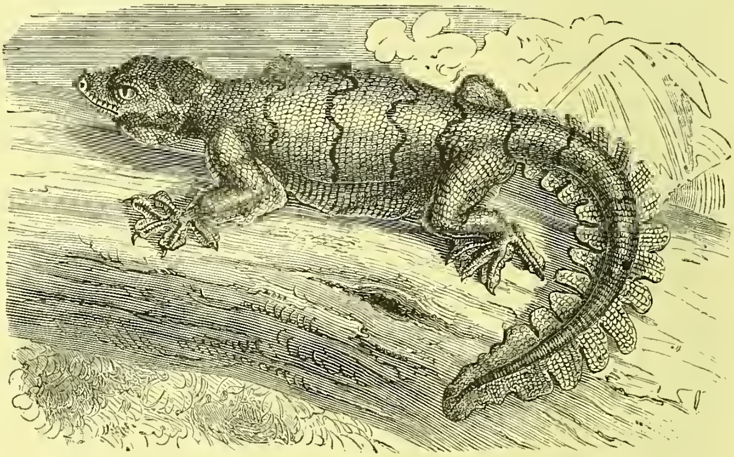
"The next day he continued very fierce. I hung the cage out in the sun. Two or three times in the course of the day I observed him green, but for the most part he was black. The changes were rather quickly accomplished.

"After he had been in my possession about four days, I observed him one morning sloughing his skin; the delicate epidermis, loosened from his body and legs, looked like a garment of thin white muslin, split irregularly down the legs and toes, and separated from that of the tail on which the integument yet adhered unbroken. Throughout the day the loosened skin hung about the animal, though more and more loosely. He had not abated a whit of his fierceness, leaping at a stick pointed at him, and seizing it forcibly in his teeth.

"Another individual, caught in the same locality, and by the same device, I introduced into the cage of the former, who did not offer any molestation to the intruder. After they had remained in my possession, the one about six weeks, the other about four, they both died, almost on the same day, and both in the process of sloughing. In this operation the skin appears to be first separated from the head, for in one of these it was perfectly loose from the whole head, and was removable in one piece, but to the neck and entire body it still adhered by organic union. I suspect that the sloughing of the skin is, at least sometimes, the result of universal excitement. All that I have taken alive and caged (amounting to many individuals), after most violent behaviour at first, soon sloughed, usually the next day.

"The food of the lizard appears to include both vegetable and animal substance. I was never able to induce one to eat in captivity, but the dissection of several has given me this result. Thus, in one I found hard seeds and farinaceous substance; in another the fragments of a brilliant curculionidous beetle and other insects. I once observed a large one on the summit of a mountain deliberately eating the ripe glasseye berries, munching half of one away at a mouthful.

"It would require no great warmth of imagination to identify these sunny, spicy, pomiferous groves with golden-fruited gardens of the Hesperides, and this fierce, sinister, saw-crested lizard with the watchful dragon that guarded them. If I had had the naming of him, I would have called him Ladon."



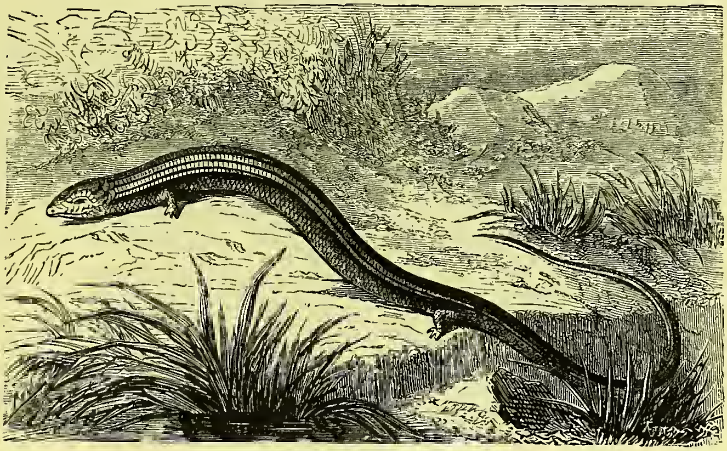
THE WALL GECKO (*Platydactylus muralis*).

FAMILY XII.—GECKOTIDÆ.

The Geckos, or Wall Lizards, form a well-marked family, consisting of about fifty genera, and upwards of two hundred species. They are found all over the warm regions of the globe, and they are to be met with in the most distant islands. They have several well-marked characteristics. Their tongues are short and fleshy; their eyes are covered with a transparent eyelid; their toes have for the most part a leaf-like expansion, which enables them to cling to and walk on even polished perpendicular surfaces. They are mostly nocturnal, move about without any noise, and are insect eaters. While the feet are short and five-toed, the thumbs on the front feet are often nearly absent, and all the toes are more or less unequal; the nails are sometimes wanting, and sometimes, when present, are retractable as in the cat tribe. The name Gecko is said to be given to them from the noise they make. They are fond of living in human habitations, where they are very useful in destroying insects; but from their somewhat repulsive appearance they are too often persecuted under the quite false pretence that they are poisonous.

One species, the Wall Gecko (*Platydactylus muralis*), is not uncommon in the South of France, Italy, Spain, and Greece. We have found it very common in Sicily, both frequenting old ruins as well as in houses. Hemidactylus verruculatus is also a South European species; while Phyllodactylus europeus seems to be peculiar to the Island of Sardinia, if Prince Bonaparte has made no mistake, and Stenodactylus guttatus is found in Greece. Space would quite fail us if we were even to enumerate the species found in Madagascar, the Seychelles, the Sandwich Islands, and the Philippines. One species (*Thecadactylus lævis*), found in Jamaica, seems to have a walk like a frog, and is to be heard all day long as it looks down from the rafters.

"The commonest of the lizards of Labuan," writes Dr. Collingwood, "and indeed of the whole region, is the little animal called Chick-chack (*Ptyodactylus gecko*), so named from the chirping noise it makes from time to time, and which might be first mistaken for the voice of a bird. They are perfectly harmless, and often very familiar. They live in considerable numbers within doors, concealing themselves upon the roofs and among the attaps, or palm-coverings, or crawling about upon the walls and ceilings. I have counted as many as two dozen overhead while I have been at dinner in a good-sized room, some as long as my hand, and usually pale-coloured. They vary, however, somewhat in colour, according to food and locality. I have been informed by credible friends of instances in which they would habitually come down upon the table and take food offered to them; and it is equally certain that they occasionally come down involuntarily, losing their precarious footing overhead while in chase of an insect, in which case they fall with a thump upon the floor or table, an accident which usually results in the loss of their tails, which break off with the shock or the fright; and it is by no means unusual to see them with their short stumpy caudal appendages in process of reproduction. Such an occurrence happening in the night, I have found rather startling. If a moth or butterfly flutters near the ceiling, the chick-chacks are all upon the alert, running at it as it passes near them; and although the reptile may succeed in catching it, the insect is often too unwieldy for them, and they have considerable difficulty in securing it. They clear the house of mosquitoes and flies, however, and are never molested, but, on the other hand, always encouraged. A singular circumstance occurred to the colonial surgeon who related it to me: he was lying awake in bed when a chick-chack fell from the ceiling upon the top of his mosquito-curtain. At the moment of touching it the lizard became brilliantly luminous, illuminating the objects in the neighbourhood, much to the astonishment of the Doctor, who had never before witnessed such an occurrence."


THE SAND-LIZARD (*Seps tridactylus*).

FAMILY XIII.—ACONTIADÆ.

This is a small family of snake-like lizards, with short conical teeth. The tip of their snout is covered with a broad scale; their nostrils are very minute. The tongue is free and nicked at the end. The body is long, and serpent-like. Either the feet are altogether wanting, or there are but the vestiges of them. The tail is short and rounded. The eyes are very small, either without an eyelid or with a single inferior eyelid. There are not more than some eight species known. Acontias subcæcus is from West Africa; both the two species of Nessia (*N. burtonii* and *N. monodactyla*) are found in Ceylon; they seem to be small burrowing reptiles.

FAMILY XIV.—SEPSIDÆ.

The sand-lizards form a natural group of about twenty-four species, almost exclusively found in Africa. A few are found in Southern Europe, extending into Syria and to Afghanistan. They have mobile eyelids. The feet are short, with three or four clawed nails. The common Sand Lizard (*Seps chalsides*) is not rare in the South of France; it is common all over Italy, and is probably to be found on both sides of the Mediterranean.

Several species of this genus are found in Madeira, Madagascar, and South Africa. Sphenocephalus tridactylus is the species found in Afghanistan.

FAMILY XV.—OPHIOMORIDÆ.

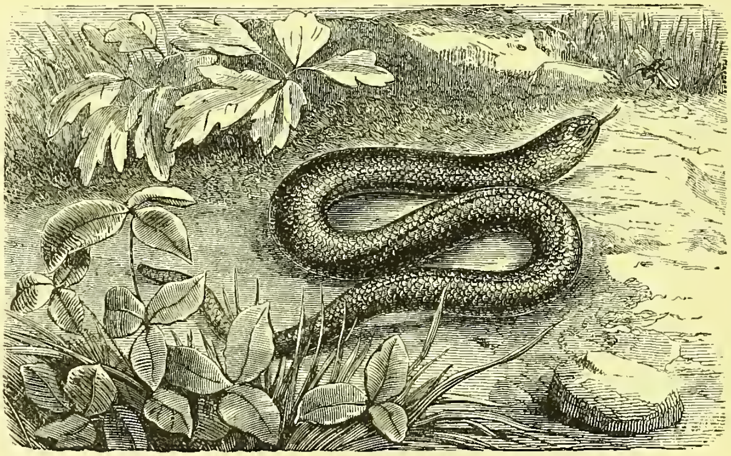
This family contains but two genera and two species. Ophiomorus miliaris was at one time placed in the genus Anguis, which is referred to under the next family. It has conical-shaped blunt teeth; the tongue is scaly, and there are only the rudiments of legs hid under the skin. It is found in Southern Russia, in the Morea and in Algiers. Zygnopsis brevipes, with four fully-developed legs, has lately been discovered by Mr. Blandford, in South Persia.

FAMILY XVI.—SCINCIDÆ.

The Skinks form a very numerous family of some 300 species, placed in about 64 genera. Their tongue is not extensile, and is flat and mostly emarginate, and beset with scaly protuberances. On most of them there are four feet, and these, when present, vary in the number of toes, some having five, others four. The eyelids are movable. Teeth are found, not only on the jaws, but in the palate of the mouth. Their ears are exposed; and the neck and body are pretty nearly equal in bulk. They are mostly of small size, fond of dry sandy places, and nestling under stones and in holes. They feed on insects and worms. Every one who has visited Egypt must have noticed the Skink (*Scincus officinalis*), which is to be seen in every sandy, stony spot. To it was attributed some wonderful medicinal virtues, and it was regularly sold in the apothecaries' shops. It is said to have been found in Greece, but this seems doubtful.

One of the best-known Asiatic species is the Common Indian Skink (*Euprepes rufescens*). It is most widely spread, being found on every part of the continent, from Afghanistan to China. It is seldom found at elevations over 8,000 feet. It fearlessly enters houses in pursuit of insects.

A North American species (*Plestiodon laticeps*) is found to live in holes in trees, frequently taking up its quarters in the deserted nest of some woodpecker. When disturbed, it will frighten the intruder by suddenly jerking out its large, bright-red-coloured head. It can inflict a wound with its teeth, but it is not at all venomous, in spite of the ideas held by the Americans to the contrary.



THE BLIND-WORM (*Anguis fragilis*).

The Blind or Slow-worm (*Anguis fragilis*) possesses the outward appearance of a little snake, about ten to fourteen inches in length; the tail is blunt; the head is covered with plates; the body and tail with smooth, imbricated scales. There are no limbs, and the eyes are very minute, whence it is often called the blind-worm; it is perfectly harmless.

M. Latreille says:—"This reptile usually lives in the earth, inhabiting holes, which it bores, and which it enlarges with its muzzle. It comes up for the purpose of breathing, raising its head above the surface of the earth in which it has established its retreat. It does this sometimes in winter, though snow may be on the ground. I have found it early in the spring under moss and stones."

When irritated or alarmed, the slow-worm, by a forcible contraction of all the muscles of its body, becomes perfectly stiff, and then breaks in two with the slightest blow, or upon any attempt to bend it. Hence the term *fragilis* (brittle), given to it by Linnæus. This stiffening is the only manifestation of anger which it displays—at least, generally. We have often taken hold of this reptile, and carried it about, without its making any effort to bite, which, when much irritated, it will certainly do; but even then, so small is its mouth, and so feeble are its teeth, that it cannot inflict any injury. M. Latreille says its food consists of worms, beetles, frogs, small rats, and, as it is said, even toads. This is a mistake. Mr. Bell informs us that he repeatedly offered, but in vain, young frogs to the blind-worms.

which he kept alive: they refused even insects. With regard to frogs and rats, it is absolutely impossible for the slow-worm to swallow them. It does, however, feed on insects, earth-worms, and slugs, being particularly partial to the latter. Mr. George Daniel, in Mr. Bennett's edition of "White's Selborne," gives us the following interesting account:—

"A blind-worm, that I kept alive for nine weeks, would, when touched, turn and bite, although not very sharply; its bite was not sufficient to draw blood, but it always retained its hold until released. It drank sparingly of milk, raising the head when drinking. It fed upon the little white slug, so common in fields and gardens, eating six or seven of them at a time, one after the other. It invariably took them in one position. Elevating its head slowly above its victim, it would suddenly seize the slug by the middle, in the same way that a ferret or dog will generally seize a rat by the loins. It would then hold it thus sometimes for more than a minute, when it would pass its prey through its jaws, and swallow the slug head foremost. It refused the larger slugs, and would not touch either young frogs or mice. Snakes kept in the same cage took both frogs and mice. The blind-worm avoided the water; the snakes, on the contrary, coiled themselves in a pan containing water, which was put into the cage, and appeared to delight in it. The blind-worm was a remarkably fine one, measuring fifteen inches in length. It cast its slough while in my possession; the skin came off in separate pieces, the peeling from the head being completed the last."

Mr. Bell, however, observes that the shedding of the skin of the blind-worm takes place as in the true snakes. It is, in fact, taken off in one piece, when the animal is at liberty, and strong enough to effect it; and, like those reptiles, it leaves the skin turned inside out, attached to brushwood, or other substances, which it has employed to entangle and secure it as it was coming off.

The blind-worm produces its young alive in the month of June or July. They amount to ten or twelve in number, and are soon active and lively.

The general colour of this animal is yellowish-brown, or yellowish-grey, with a pearly lustre; a dark or black line runs down the middle of the back, and one or two parallel rows of small dark spots down each side; but these are not always to be seen. The under parts are of a bluish-black, with whitish reticulations.

It becomes torpid in winter, and is to be found in almost every country in Europe (it is, however, unknown in Ireland), and is also found in the west of Asia, and in the north of Africa.

FAMILY XVII.—LIALIDÆ.

There is but a single genus Lialis, and but three species, all found in Australia. Lialis burtonis was described by Dr. Gray, in the "Proceedings of the Zoological Society of London," for 1834. The hinder limbs are in the form of undivided scale-like organs.

FAMILY XVIII.—PYGOPODIDÆ.

This small family has two genera and three species, all of them found in Australia and Tasmania. Pygopus lepidopodus has two small rudimentary hind-legs, but is without a trace of anterior legs.

FAMILY XIX.—GYMNOPHTHALMIDÆ.

The species of this family, sometimes called the gape-eyed scinlis, from their rudimentary eyelids, have generally four weak legs, terminated by a somewhat variable number of toes. Ablepharus pannonicus is met with in Hungary and the Morea, but would seem to be rare. It is about four inches in length, with the upper part of its body of a coppery-green, the lower parts yellowish-white. Another species, A. peronii, is said to occur also in the Morea, and to have been found on the coast of Africa at Mozambique, at New Holland, and on the Sandwich Islands. Gymnophthalmus quadrilineatus is found in the Brazils. There are not more than fifteen species at present known in this family, and three or four of these have been met with in Australia.

FAMILY XX.—CHAMÆSAURIDÆ.

This family contains but a single species, Chamæsaura anguina, found at the Cape of Good Hope. The body is very snake-like, though provided with four very short, blunt, undivided feet, and the tail is very long.

FAMILY XXI.—CERCOSAURIDÆ.

This family contains but one genus, although there are some half dozen species. All of them are natives of the Brazils, or the Ecuador regions. Cercosaurus gaudichaudii is found in the Andes of Western Ecuador. C. rhombifer has been described from the same district by Dr. Günther. It is about seven inches in length, is of a brownish-grey colour, and is figured in the "Proceedings of the Zoological Society" for 1859, Plate XX.

FAMILY XXII.—IPHISADÆ.

This family was formed by Dr. Gray for a species (*Iphisa elegans*) discovered in Para by Messrs. Wallace and Bates. The eyes are large; the feet weak and short, and covered with broad smooth shields; the toes are five in number. The colour is an olive-brown, marbled with black, beneath a yellowish-white. An excellent figure of this interesting form will be found in the "Proceedings of the Zoological Society" for 1851, Plate VI.

FAMILY XXIII.—CHIROCOLIDÆ.

Of this family only two species are known, which inhabit Brazil. One of these (*Chirocolus imbricatus*), described by Spix, has five fingers on the hind feet, and four on the anterior feet, with a trace of a thumb.

FAMILY XXIV.—ZONURIDÆ.

This family contains some sixteen genera, and over fifty species. The species have all got on each side of their abdomen a remarkable longitudinal fold of skin. Mr. Wallace specially notices the strange geographical distribution of the species of this family, the mass of which form two groups, one to be found in South Africa, and the other in Mexico, countries between which it would be difficult to imagine any means of communication. Some of the species are well known. Zonurus griseus and all the species of this genus are from South and East Africa and Madagascar. Gerrhonotus nudicollis, and the other species (twenty-one) of this genus, are from America, ranging from British Columbia to Mexico. The Glass Snake of the Americans (*Ophisaurus ventralis*) grows to about two feet in length. There are no feet, and the tail is longer than the trunk; the tail is very brittle, and being most easily broken off, gives the popular name to this creature. It is not uncommon in the United States, and many believe that it breaks its body into pieces when touched; but it need scarcely be said that it is the tail, and not the body, that thus breaks asunder.

Another most remarkable lizard belongs to this division—the scheltopusik of the Crimea and Caucasus (*Pseudopus pallasii*), which is also found in Dalmatia, Istria, the Morea, and Northern Africa. This lizard grows to a length of more than three feet; it was ranked by Cuvier among the serpents, and its little hind feet are very rudimentary, and scarcely long enough to reach the ground. Pallas is said to have first discovered it in the sandy steppes, near Astrakan.

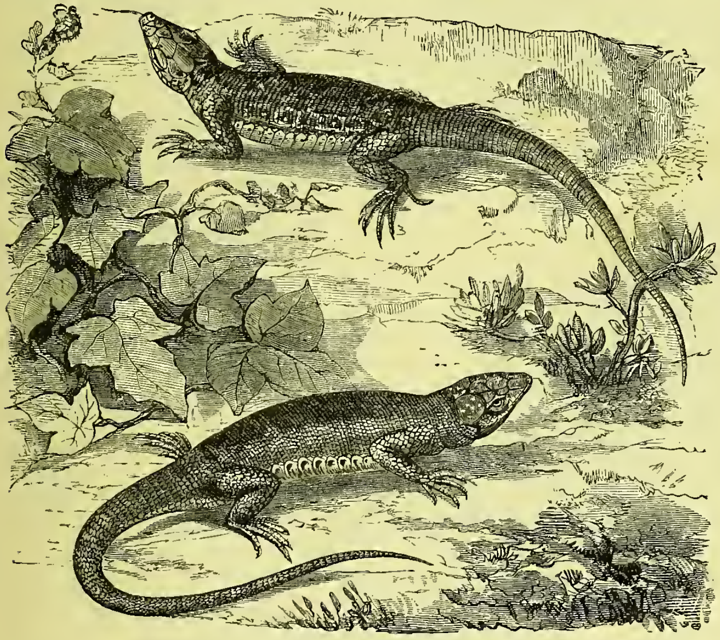
FAMILY XXV.—LACERTIDÆ.

This is a pretty numerous family, containing about eighty species. In them the body is elongate, with four five-toed feet, the toes free. The tail is often very long. The tongue is long, protrudible, and bifid. They are all inhabitants of the Old World, ranging from Central Europe, through Africa, and from Asia to Australia.

The Sand Lizard (*Lacerta agilis*) is well known. The general tint is usually sandy-brown, with obscure longitudinal marks of a darker brown, and with a series of small rounded spots down the sides, each one having a white or yellowish dot in the centre. In some, the sides are tinged with green; in others, the upper parts are green, or brownish-green; and in others, of a dull, brick-red colour.

The retreat of the Sand Lizard is a burrow, varying in depth, worked out under a tangled maze of herbage, or between the roots of a tree; and, having closed the entrance with earth and dried leaves, here it remains during the winter. It does not emerge till the warm weather has returned.

Some specimens have been seen upwards of seven inches long; but the Rev. R. Sheppard adduces an instance of one which exceeded a foot, and Mr. Bell has "occasionally seen them approaching that length, measured from the nose to the extremity of the tail." This distinguished naturalist has had abundant opportunities of observing this lizard, which, he states, is common in the neighbourhood of Poole. "Its general abode," he observes, "is on sandy heaths, where it is frequently seen crossing the small bye-paths, with considerable swiftness, although it is certainly less rapid in its movements than the smaller and more common species, the viviparous lizard. The transient glance which is thus obtained of it, together with its viperine appearance and colours, and the size and length of its body and tail, may easily have deceived Mr. Sheppard, who says that he has often mistaken it for the viper, when hastily passing by it. But it is also occasionally seen on the sunny sides of green banks, basking in the sun's rays, and retreating quickly on the approach of any intruder. Mr. Sheppard mentions that he had once or twice observed it near marshes; and it is occasionally seen in the small village of Hamworthy, near Poole, in moist situations. It has been stated, by a gentleman of my acquaintance, that the brown varieties are confined to the sandy heaths, the colours of which are closely imitated by the surface of the body, and that the green variety frequents the more verdant localities just mentioned. Be this as it may, and it is a statement which at present I can neither confirm nor refute, it is certain that these varieties, mentioned by Linnæus, and seen by Muller, do exist in the place I have named, and within a comparatively short distance."



GREEN AND OCELLATED LIZARDS.

Another species very common in Europe, but not found in Great Britain, is the Wall Lizard (*L. muralis*). M. Latreille remarks: "Every one knows this lizard, and there are few who have not, in childhood, made it an object of amusement. It is almost domestic; and its presence is the more desirable as it thins the house of annoying insects. The ancients called it 'the friend of man.' It is a harmless little creature, and lives in the chinks of walls and old buildings, where it deposits its eggs. When, on fine spring days, a bright sunlight illumines a sloping verdant bank, or a wall which reflects the heat, this lizard may be seen stretching itself on the newly-springing grass, or on the stones, as if in the enjoyment of pleasure; it revels in the grateful warmth, and testifies its satisfaction by gentle movements of its slender tail. It darts like an arrow upon its prey, or into some more commodious spot; but so far from flying on the approach of man, it appears to regard him with complacency. At the least noise, however, which alarms it, at the falling of even a leaf, it rolls itself up, tumbles down, and remains for a little time as if stunned: or it darts off, is agitated, returns, again conceals itself, re-appears, and in an instant describes a maze of tortuous circuits, which the eye can scarcely follow, folds itself up repeatedly, and at last retreats to some hiding-place, where it remains till its fear has subsided." Insects of various kinds constitute its food.

The Viviparous Lizard (*Zootoca vivipara*) is a pretty, active little creature, fond of dry, sunny banks, thickets, and copses, which is found in great abundance in most of our counties, and is freely scattered over the continent of Europe. It seldom exceeds five or six inches in length, and is very gentle and harmless.

One peculiarity of this species is its production of living young; and hence its name "viviparous." "As in all the ovo-viviparous reptiles," observes Mr. Bell, "the covering of the egg is very thin, and merely membranous; in the viper, which produces its young alive, the covering, as in the present animal, is extremely thin, and very easily torn. Although I have alluded," he adds, "to the sun's influence as being the means of hastening the evolution of the embryo, in the eggs of oviparous reptiles, it is not to be concluded that the same source of warmth is unnecessary in the present and similar instances. The only difference is, that in the ovo-viviparous species the solar heat is communicated to the embryo through the medium of the mother; and hence we often see the pregnant female, about the month of June, constantly basking in the sun, and lying in such a position as to expose the body most fully to its influence. Every one who has watched the habits of our native reptiles must have seen the same circumstance in the female of the common viper, and may have observed how much more reluctantly and tardily she leaves the genial spot than the male." This species varies considerably in markings and general colour.

Tachydromus ocellatus is met with in the East Indies, and there are seven other species of this genus. Acanthodactylus boskiana is found in Egypt, the other (nine) species are mostly African. Eremias variabilis is from Tartary, and the other species (eighteen) extend from Africa, through Persia, to China. Ophiops elegans inhabits Syria, Asia Minor, and Persia: some six other species, with nearly the same distribution, are known.

FAMILY XXVI.—TEIDÆ.

This family contains some seventy-five species, all of them confined to America. Indeed, they seem to represent the previous family in the New World. They differ from the Old World lizards, in having their solid teeth firmly fixed in deep grooves in their jaws, often growing to these and being directed in a slanting manner outwards. Many of the species are of considerable size, and species are to be found from Patagonia to California. The Teguexin (*Teius teguexin*) is not uncommon in Surinam and the Brazils. It attains a length of from three to four feet. The tail is longer than the body. Its back is black, with yellow spots. It lives on insects, worms, and frogs, and resides in holes in the earth or in the hollow trunks of trees. It is said to visit poultry-yards in search of eggs and even young chickens, and when brought to bay by dogs it fights boldly, inflicting severe wounds. Crocodilurus dracæna lives in marshy grounds in South America. It is about two feet and a half in length, and being covered over with scales, like those on the crocodile, resembles to a great extent these larger and much more formidable beasts.

"The Ground Lizard of Jamaica (*Ameiva dorsalis*) is," says Mr. Gosse, "very common on that island. It is to be seen scratching like a bird among the sand; or peering from beneath the shadow of a great leaf; or creeping stealthily along, keeping its chin to the earth; or shooting over the turf with such rapidity that it seems to fly rather than run; and one's prejudice must indeed be strong against the reptile race if one can behold its gentle countenance, its timid but bright eyes, its chaste but beautiful hues, its graceful form and action, and its bird-like motion, with any other feeling than admiration. It feeds principally on cockroaches, caterpillars, and small beetles. It is essentially terrestrial, never climbs trees, and never voluntarily takes to the water. An adult male measures about eighteen inches in length, of which the tail would measure at least twelve inches. The genus to which this lizard belongs contains nearly sixty species, having much the same geographical area as the entire family."

FAMILY XXVII.—HELODERMIDÆ.

This family was founded by Dr. Gray for an extraordinary lizard found in Mexico, called the Caltetepon (*Heloderma horridum*). In the front portion of its jaw the teeth are furrowed, as if for the conveyance of some poisonous fluid. It is believed to be very venomous by the natives of Mexico, and the structure of its teeth is almost unique among the lacertine reptiles.

FAMILY XXVIII.—VARANIDÆ.

This is the last large family of this order, and contains the water-lizards, of which there are about three dozen species, none of which are to be found in America. They are often called monitors, and, after the crocodiles, are the largest of the lacertine reptiles, some attaining to a length of more than six feet. In most the tail is compressed at the sides and keeled above, thus giving it greater power in the water. It has been said that one well-known species gives notice of the presence of the crocodile by a sort of whistling noise: hence the name monitor.

Perhaps the largest species is the Nile Monitor (*Varanus niloticus*). This species appears on the monuments of the ancient Egyptians, probably from its devouring the eggs of the crocodile. It is still very common in the great river of Egypt; it is also found in Senegal and near Sierra Leone, as well as in the rivers of Southern Africa.

Sparrmann says: "One of this species of the middle size, which, together with its two young ones, I brought home with me from Agter Bruntjeshoogte, was about two feet long in the body, and three in the tail. Having caught her by the neck, so that she could not bite me, and finding that it required some strength to hold her fast, I got a large worsted needle, and gave her several punctures with it, not only in the heart, but in every part of the cranium which was in contact with the brain. This, however, was so far from answering my purpose, which was to kill her in the most speedy and least painful manner, without mangling or mutilating her, that she seemed still to have life enough left to be able to run away. After this, my host undertook to put an end to her; and having given her several hard squeezes about the chest, and tied her feet together, hung her up by the neck in a noose, which he drew as tight as he possibly could. From this situation she was found, in the space of forty-eight hours, to have extricated herself, though she still remained near the farm, appearing, at the same time, to be almost entirely exhausted. Upon this, we

THE NILE MONITOR (*Varanus niloticus*).

tied her feet close behind her, so that with her long and sharp claws, of which she had five upon each foot, she could not damage the serpents and other animals which I kept in a cask of brandy, and among which I put her with my own hands, holding her a long time under the surface of the liquor. Yet she was so far from being suffocated immediately, that she flounced about, and even a quarter of an hour afterwards convinced us by her motions that she had still some life remaining in her."

The Land Crocodile of Herodotus is probably a Varanus (*Psammosaurus arenarius*), which is not only found over North-eastern Africa, but extends to North-western India. Another interesting species (*Hydrosaurus bellii*) is found in Australia, and some other species of this genus are to be found in New Guinea and the Philippines.

FAMILY XXIX.—LEPIDOSTERNIDÆ.

With the species of this family we enter upon a small section of lizards, which—were it not for the very short thick tongue, which cannot be protruded, and that the bones of the lower jaw are joined in front by a firm union—might be placed among the species of the next order (the snakes). Feet are almost altogether wanting, and the forms are wonderfully serpent-like. This, the first family of this section, contains some half dozen species, found in the tropical parts of Africa and America. They have small, short, conical heads, and round blunt tails. Lepidosternon microcephala is from Brazil; and Cephalopeltis scutigera, also from Brazil, is like a big earth-worm. Monotrophis capensis, said to be pink when alive, is found in South Africa, and possibly extends up along the east coast to Mozambique. Dalophia welwitschii is from Angola.

FAMILY XXX.—AMPHISBÆNIDÆ.

The Amphisbæns are small worm-like reptiles, to be found sparsely scattered over the region of South America, Southern Europe, Africa, and New Zealand. The European species (*Amphisbæna cinerea*) is about ten inches in length. The skin of the body seems divided into a number of compartments, which resolve themselves into a number of ring-like divisions: of these the body contains about 125 and the tail eighteen. It is to be found in Portugal, Spain, and North Africa, and was described by Domingos Vandelli so long ago as 1780. Dr. Gray has divided the species into eight genera. We follow Dr. Günther in regarding them as all referable to the type genus. The largest species (*A. alba*) is about nineteen inches long, and comes from Surinam. Linnæus seems to have described it from a bleached specimen, as its natural colour is a reddish-yellow.

FAMILY XXXI.—CHIROTIDÆ.

This family contains but one species (*Chirotes canaliculatus*). It is a small animal, with two feeble front limbs placed near the head, with five-fingered broad hands, four of the fingers on each hand with nails. It is found in Mexico.

FAMILY XXXII.—TROGONOPHIDÆ.

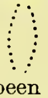
The only species in this family (*Trogonophis wiegmanni*) is a little footless reptile, found in Tangiers and Algeria. It is yellow, with red-brown four-sided spots, arranged like a chess-board.

ORDER IV.—SNAKES (*Ophidia*).

The general form of the species of this order, which now numbers nearly one thousand, is well known, and the popular notion that a snake is a reptile destitute of feet is not very far from being correct; but a more critical and equally characteristic feature is to be found in the peculiar structure of the jaws in the serpents. Their mouth is exceedingly dilatable; nearly all the bones of the upper jaw and the palate are freely movable, and the two sides of the lower jaw are united in front by a series of muscles and ligaments, which admits of their being separated to a very large extent at the pleasure of the animal; and not only this, but these jaws are themselves articulated (jointed), not to an immovable part of the skull itself (mastoid), but to a portion of the skull case, which is itself movable, and is only attached to the rest of the skull by muscles: and thus the mouth is able to open, as it were, long below the head. Serpents glide along by fixing the free extremities of their numerous ribs on the ground. Their movements are often very rapid. They seem to prefer damp moist places. Some of them attain an immense length, growing to a length of twenty or thirty feet.

Before commencing our consideration of this order with the Venomous Snakes, of which the first family will be that of the true Vipers, we extract the following remarks on the danger of snake-bites and their treatment from Dr. Günther's learned treatise on "The Reptiles of British India":—

"The degree of danger depends but little on the species which has inflicted the wound, but rather on the bulk of the individual, on the quantity of its poison, on the temperature, and on the place of the wound. Large snakes have generally larger fangs, penetrating more deeply into the flesh, and produce and inject a greater quantity of poison: the bite of a snake not exceeding eighteen to twenty inches in length will rarely be followed by a fatal result when the wounded person is an adult. Further, it has been experimentally proved that a snake which has bitten several times within a short time exhausts its stock of poison, and the effects of the fourth or fifth bite are much less dangerous than of those preceding, and it may, indeed, be entirely harmless. Therefore the danger from a snake which has bitten a person shortly after it has fed is considerably reduced. The temper of snakes generally depends much on the temperature, so that the same individual snake which shows itself extremely fierce during the hottest part of the day becomes sluggish when the temperature sinks, biting only when provoked, and with but little energy. The parts of the human body in which a wound inflicted by a snake is most dangerous are those which are distinguished by the abundance of blood-vessels, or those which can be caught by the snake between both its jaws, so that the animal is enabled to fix its fangs deeply. If, unfortunately, a large blood-vessel is pierced by the fang, the poison is carried instantaneously into the mass of the blood, and sudden death is almost always the result.

"Although it is always possible to recognise the venomous nature of a snake from external characters only, yet this requires such a knowledge of snakes as can be obtained only by a special study of them; it would, therefore be a useless attempt to enumerate here the different characters by which a dangerous species may be distinguished externally from a harmless one. The wound itself speaks for or against the venomous nature of a snake which  has bitten. When there are numerous punctured wounds disposed in two lines, thus the snake is not poisonous; but when there are only two (. .) they are most probaby inflicted by a venomous snake, although there is still some hope that it may have been one of those innocuous snakes, which have long, non-perforated fangs in front (Lycodonts, Dipsades, &c.). In such a case much anxiety may be spared if the snake is killed at once and properly inspected.

"The treatment to be followed in all cases of poisoned wounds caused by snakes must be local as well as internal; and both must be resorted to at once, especially the former, immediately the accident has happened.

"1. If the wound is on some part of the hand, arm, or foot, one or two ligatures should be made as tightly as possible at a short distance above the wound, to prevent the absorption of the poison. The ligature is left until the proper means are taken to destroy the virus in the wound, and until medicine is taken internally, or until great pain or swelling necessitates its removal.

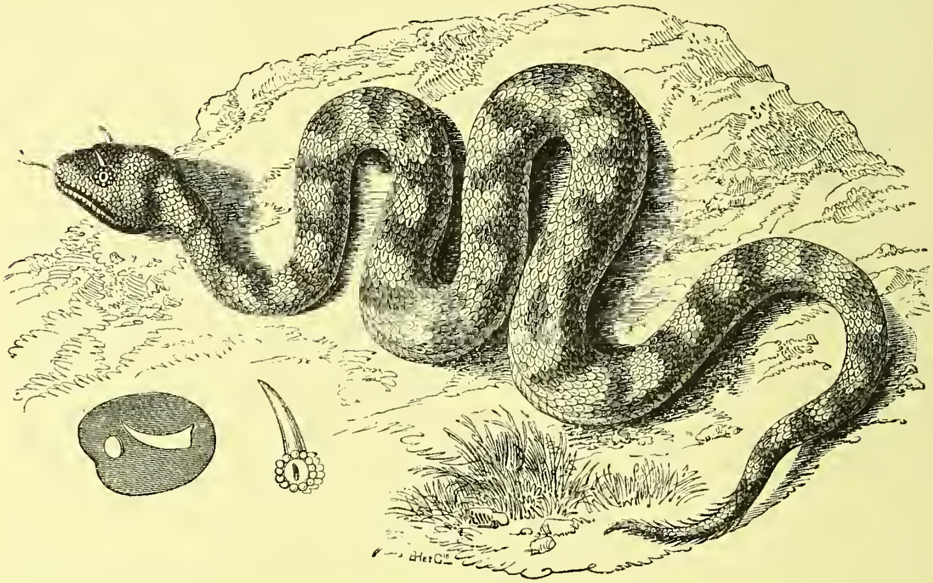
"2. The punctured wounds are to be enlarged by incisions at least as deep as the wounds, to cause a free efflux of the poisoned blood, and so facilitate its removal by sucking.

"3. The wounds should be sucked either by the patient himself or by another person whose mouth is free from any solution of continuity; cupping-glasses answer the same purpose in cases where they can be applied.

"4. The wound should be washed with ammonia, and its vicinity rubbed with it. Cauterization with a red-hot iron, or with sulphuric acid, butter of antimony, nitrate of silver, &c., are of great advantage, if done before the virus has spread far beyond the place of the bite.

"5. Internally, ammonia should be taken in large doses—one, two, or three wine-glasses of the eau-de-luce. Where this is not at hand, from one to six glasses of brandy may be taken at short intervals.

"In all accidents caused by the bites of snakes, the action of the heart is much affected; its contractions become feeble, the respiration difficult, and the patient feels great anguish, or sinks into a fainting state. To prevent a complete collapse it is necessary to use these strong excitants, and to repeat them until the alarming symptoms are allayed. It would be a great risk in such a case to trust to the remedies of a snake-charmer."



THE HORNED SNAKE (*Vipera cerastes*).

FAMILY XXXIII.—VIPERIDÆ.

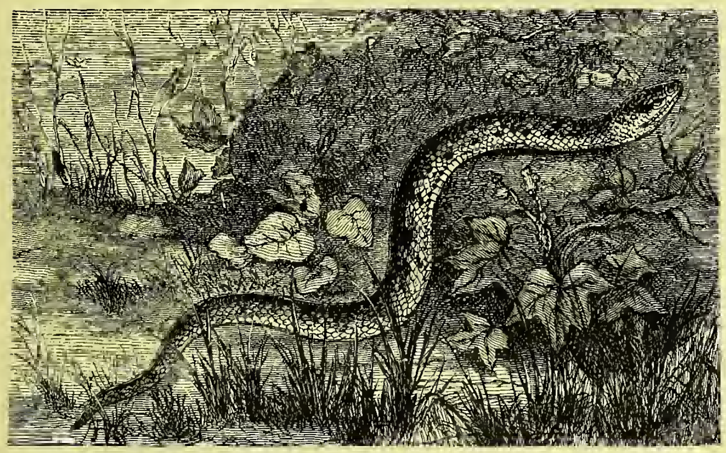
The species (about twenty-two) of this family have poison fangs (a single large perforated tooth on each side of the upper jaw); they are all from the eastern hemisphere, being especially abundant in Africa.

Of the more remarkable species we must mention the Horned Snake (*Vipera cerastes*), which is found abundantly in Egypt. This serpent was well known to the ancients, and is distinguished by the presence of a little horny spur above each eye. Its general length is about two feet, and the colour sandy red or yellow, with irregular brownish markings, whence it harmonises with the colour of the sands of the desert, where it lives, and cannot be easily distinguished.

"So grateful is heat to this snake," says Bruce, "that though the sun was burning hot all day, when we made a fire at night, by digging a hole and burning wood to charcoal in it, for dressing our victuals, it was seldom that we had fewer than half-a-dozen of these vipers burned to death by approaching the embers."

This species has acquired a historical celebrity, from having been the supposed cause of Cleopatra's death.

Of the European species, the Viper (*P. berus*) is the most wide-spread, being found all over Central Europe as far to the north as Sweden, and from Southern Italy to Siberia. It is, happily for us, the only British venomous reptile; and its venom, in our country at least, is not by any means so virulent as that of the serpents in hotter regions. In the case of a bite, ammonia or hartshorn given internally, and fomentations applied to the part, which is to be gently rubbed afterwards with oil, are the remedies usually employed. The instances are very rare in which the bite has proved fatal; and then the sufferer has been in delicate health.

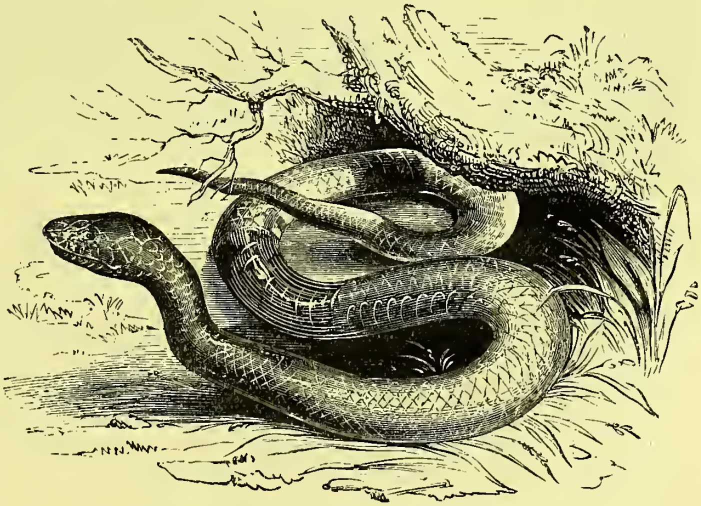


THE VIPER (*Pelias berus*).

The viper varies constantly as to colour; the ground colour is mostly olive, sometimes deep brown, sometimes yellowish-brown, and sometimes brick red. A mark between the eyes, a spot on each side of the head, and a broad zig-zag stripe, composed of confluent rhomboidal spots down the back to the end of the tail, are darker than the ground colour, and sometimes black.

The viper brings forth its young alive. These, though but a few inches in length, crawl about, and are as fierce as the parent, throwing themselves, when molested, into an attitude of defence, and hissing with anger.

"Several intelligent folks," says White, of Selborne, "assure me that they have seen the viper open her mouth to admit her helpless young down her throat, on sudden surprises, just as the female opossum does her brood into the pouch upon the like emergencies; yet the London viper-catchers insisted on it to Mr. Barrington that no such thing ever happens."



THE ASP (*Vipera aspis*).

Mice, lizards, and nestling birds are the food of this species. "I have in my possession," says Mr. Bell, "a specimen of a small viper, taken on Poole Heath, in Dorsetshire, in a dying state, in the act of attempting to swallow a mouse, which was too large for it, the skin of the neck being so distended as to have burst in several places."

The variety called "Chersea" is common in Southern Italy.

The Asp (*V. aspis*) inhabits desert, stony, and hilly districts throughout nearly the whole of Europe, and is not uncommon about Paris. V. ammodytes is the only other European viper, and is chiefly to be met with in North Italy, the Dolomite country, and Greece.

FAMILY XXXIV.—CROTALIDÆ.

This family contains about forty species of Pit Vipers—so called from having a deep pit on the side of the snout—and among them is the formidable Rattlesnake. None of them are to be found in Europe, or in Africa, or in Australia; but they are very numerous in America, and a few are to be met with in Asia and the East Indies.

The Rattlesnake (*Crotalus horridus*) has a number of horny rings fastened to the end of its tail, which move the rattle. In some adult animals the rattle consists of from twenty to thirty hollow horny joints. These are of a pyramidal figure, articulated one within the other, so that the point of the first joint reaches as far as the basis or protuberant ring of the third, and so on; which articulations, being very loose, give liberty to the joints that are enclosed within the outward rings to strike against the sides of them, and so to cause the rattling noise which is heard when the snake shakes his tail.

M. Palizot-Beauvois says :—" Frightful as this reptile appears to the eyes of prejudice, certain it is that few animals are more peaceful and less inclined to do mischief than the rattlesnake. It never attacks animals on which it does not feed; and if it be neither alarmed nor molested, it never attempts to bite. I have often traversed a path, at a distance of a foot from a rattlesnake, without its displaying the slightest desire to seize me. I have always been warned of its presence by the noise of its rattle; and while I have retreated without any great haste, it has never stirred from the spot, never changed its posture, but has given me time to cut a stick for the purpose of despatching it. Dangerous as its bite is supposed to be—and which in fact it is, during certain months of the year, and especially if the tooth pierces a blood-vessel—still, when the reptile has retired to its winter abode it may be handled without danger; not that it is to be found there in a state always of torpor and inactivity, for it is only in the middle of winter and during hard frosts that we find these animals intertwined together in ball-like masses and totally torpid. On the approach of spring, the season in which, if I may so express it, serpents re-appear among the number of living beings, the rattlesnake begins to move; at first, as if to rouse itself from its torpor and try its strength, it crawls slowly among the roots of trees; by degrees it becomes more animated, and the more so as the time of its liberation approaches. Sometimes a fine day temporarily hastens this epoch, and they creep forth from their holes, stretch themselves, and bask in the sun; but still they will not bite. Burdened with their old skin, which they are waiting for the time to throw off, their sight, as in all other serpents, is very defective; and they seem to me as if they are labouring under some malady which takes away both the desire and the power to injure.

" In the month of February, 1797, we went with Mr. Pence, of Philadelphia, to hunt for rattlesnakes, which are numerous in New Jersey; we caught nine, and almost all with the hand, in the space of two hours. Although they had already begun to sound their rattles, not one of them displayed the least inclination to bite.

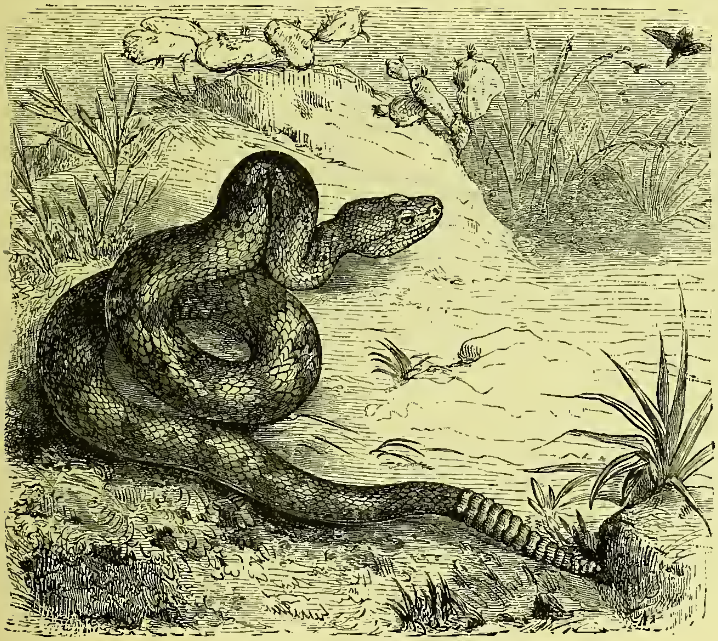
" In summer this reptile is more dangerous; but, as I have already said, it is never until after being alarmed, or touched, or struck: it then, indeed, instantly coils itself round, and warns, by its hissing and the rapid rattling of its tail, of its angry desire for vengeance. Then woe to the man or animal within its reach !

" Its bite, from the moment it emerges from its retreat till August, does not necessarily produce fatal results. It has been remarked, and the observation has not escaped the Indians, that from the month of August to the time when it is about to retire to its winter quarters, the period in which it takes the most food, it becomes terrible, and its bite mortal.

" We know that serpents in general retire on the approach of winter, according to the nature of the ground, and the temperature of the place they tenant, either under large stones or into holes which other animals have burrowed. The rattlesnake gives preference to places in the vicinity of water. We have dug up many of their holes on the borders of the river Maurice. They were all tortuous, and led to a sort of chamber, distant from the entrance six or eight feet; and there we have found them in balls, and twined together. Our guide led us, on one occasion, into a marshy place, covered with a prodigious quantity of *Sphagnum palustre*, a kind of moss, of which the stems are from six to twelve inches high. Having removed some of this moss, of which the top was frozen (the frost being so severe that it penetrated the naked ground to the depth of twelve or fourteen inches), we perceived many rattlesnakes, slowly creeping among the roots of the trees, immediately beneath the moss, and on an oozy ground, over which flowed running water not affected by the frost. Here I would make a passing remark, that this fact may be turned to account by persons employed in agriculture or gardening; this moss might be employed for the preservation of delicate plants liable to be killed by the severity of winter."

The Asiatic species of pit vipers are a good deal smaller in size than the American species, and are much more dangerous. They want the rattle of the American species, though in some species of the genus Halys there is a simple spine-like caudal scale.

The species of the genus Trimeresurus have prehensile tails, and are mostly of a green colour and live in trees. In general, says Dr. Günther, they are sluggish, not attempting to move out of the way, and as they very closely resemble the branch on which they rest, they are frequently not to be seen until they prepare to dart, vibrating the tail and uttering a faint hissing sound, or until they have bitten the disturber of their rest. Accidents caused by these snakes, therefore, are not of unusual occurrence, and it is a fortunate circumstance that comparatively but few examples attain to a size of more than two feet, so that the consequences of their bite are less to be dreaded than of other poisonous snakes. Indeed, numerous cases are on record which show that the symptoms indicating a general effect on the system were of short duration, extending only over the space of from two to forty-eight hours, and confined to vomiting, nausea, and fever. After the pain and swelling of the bitten member or spot have subsided, the vicinity round the wound becomes discoloured, mortifies, and is finally thrown off as a black circular slough, after which health is speedily restored. The bite of the larger specimens, from two to three feet long, is more dangerous, and has occasionally proved fatal: so that the greatest care should always be observed in the immediate treatment of the patient.



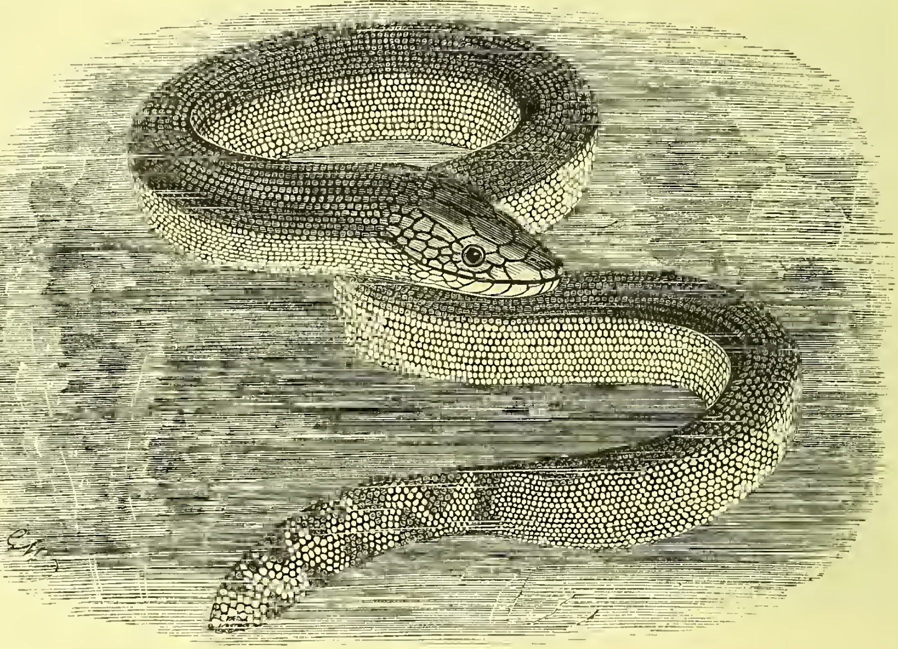
THE RATTLESNAKE (*Crotalus horridus*).

When roused, these snakes are extremely fierce, striking at everything within their reach; and Cantor says that in the extreme of fury they will fix the fangs in their own bodies. Frogs, mammals, and birds form their food, and I have never found a lizard or snake in their stomach. The Trimeresures occur only in the East Indies. They are provided with a singular pit in the loreal region, but we are not at present acquainted with the use of this organ. Trimeresurus gramineus is common in Cochin China.

Calloselasma rhodostoma is found in Java and Siam, and is one of the most beautiful and most dangerous of the venomous snakes. It frequents grassy plains, and approaches gardens and human dwellings. Kuhl was a witness of a case where two men having been bitten by one and the same snake expired five minutes after. It grows to a length of three feet.

The "Carawala" (*Hypnale nepa*) is found in Southern India and Ceylon. It is much dreaded, although its bite is not exceptionally fatal to man, nor does death occur before the lapse of some days.

Mr. Darwin, in "The Voyage of a Naturalist," writes of a snake (*Craspedocephalus crotalinus*) that, "from the size of the poison channel in its fangs, must be very deadly. Cuvier, in opposition to some other naturalists, makes this a sub-genus of the rattlesnake, and intermediate between it and the viper. In confirmation of this opinion, I observed a fact, which appears to me very curious and instructive, as showing how every character, even though it may be in some degree independent of structure, has a tendency to vary by slow degrees. The extremity of the tail of this snake is terminated by a point, which is very slightly enlarged; and as the animal glides along, it constantly vibrates the last inch; and this part, striking against the dry grass and brushwood, produces a rattling noise, which can be distinctly heard at a distance of six feet. As often as the animal was irritated or surprised, its tail was shaken, and the vibrations were extremely rapid. Even as long as the body retained its irritability, a tendency to this habitual movement was evident. It has in some respects the structure of a viper, with the habits of a rattlesnake, the noise, however, being produced by a simpler device. The expression of this snake's face was hideous and fierce; the pupil consisted of a vertical slit in a mottled and coppery iris; the jaws were broad at the base, and the nose terminated in a triangular projection. I do not think I ever saw anything more ugly, excepting, perhaps, some of the vampire bats.



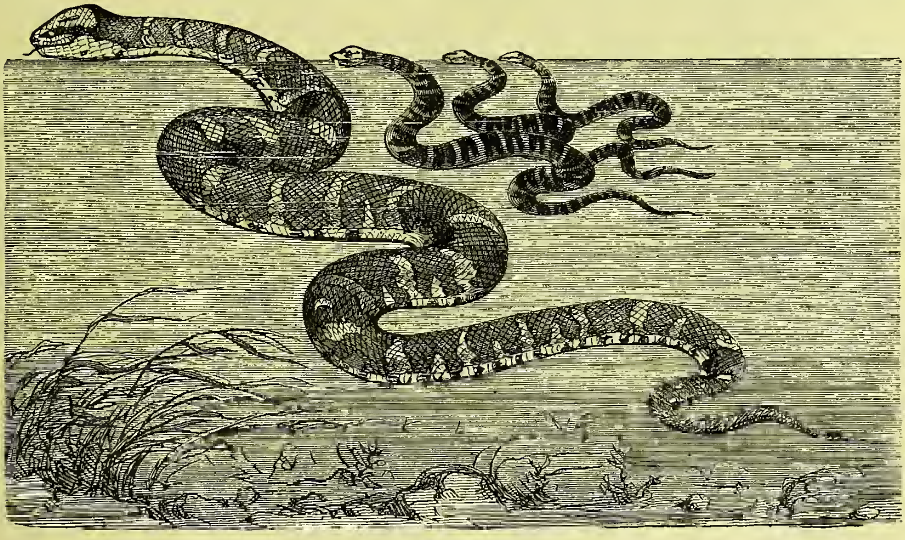
THE MARINE SNAKE (*Pelamys bicolor*).

"I imagine this repulsive aspect originates from the features being placed in positions with respect to each other somewhat proportional to those of the human face; and thus we obtain a scale of hideousness."

FAMILY XXXV.—HYDROPHIDÆ.

These snakes are abundant in the Indian and Australian seas, and extend as far west as Madagascar and as far east as Panama. Perhaps the commonest species is Pelamis bicolor; it occurs in both the Indian and Pacific Oceans, but does not exceed three feet in length. They pass their whole life in the water (with the exception, perhaps, of Platurus), and soon die when brought on shore.

"The most striking feature in the organisation of the sea-snakes is their elevated and compressed tail, the processes of the caudal vertebræ being much prolonged and styliform. The hind part of the body, and sometimes forwards to beyond the middle of its length, is also compressed, and the belly forms a more or less sharp ridge. The ventral shields would be of no use to snakes moving through a fluid, and not over a rough, hard surface, and therefore they are only rudimentary or entirely absent. The genus Platurus, however, is a most remarkable exception in having ordinary ventral shields; and this circumstance, together with the lateral position of its nostrils, induces me," writes Dr. Günther, "to believe that these serpents frequently go on shore, sporting or hunting over marshy ground. In many sea-snakes the hind part of the body is curved and prehensile, so that they are enabled to secure a hold by twisting this part of the body round corals, seaweeds, or any other projecting object. Their tail answers all the purposes of the same organ in a fish, and their motions in the water are almost as rapid as they are uncertain and awkward when removed out of their proper element. Their nostrils are placed quite at the top of the snout, as in crocodiles and in fresh-water snakes, so that they are enabled to breathe whilst the entire body and greater part of the head are immersed in the water. These openings are small and sub-crescentic, and provided with a valve interiorly, which is opened during respiration and closed when the animal dives. They have very capacious lungs, extending far backwards, and, consequently, all their ribs are employed in performing the respiratory function; by retaining a portion of the air in these extensive lungs, they are enabled to float on the surface of the water without the slightest effort. The sea-snakes shed their skin very frequently, and the skin peels off in pieces, as in lizards, and not as in fresh-water serpents, in which the integuments come off entire. Several species are remarkable for the extremely slender and prolonged anterior part of the body, for which we use the term 'neck,' and which terminates in a very small head.



SEA SNAKES.

"The eye is small, with round pupil, which is so much contracted by the light when the snake is taken out of the water that the animal is blinded, and is unable to hit any object it wants to strike.

"The food of the sea-snakes consists entirely of small fish. I have found all kinds of fish in their stomach, among them species with very strong spines (Apogon, Siluroids). As all these animals are killed by the poison of the snake before they are swallowed, and as their muscles are perfectly relaxed, their armature is harmless to the snake, which commences to swallow its prey from the head, and depresses the spines as deglutition proceeds. There cannot be the slightest doubt that the sea-snakes belong to the most poisonous species of the whole order. Russell and Cantor have ascertained it by direct observation; tortoises, other snakes, and fish die from their bite in less than an hour, and a man succumbed after four hours. Accidents are rarely caused by them, because they are extremely shy, and swim away on the least alarm; but when surprised in the submarine cavities forming their natural retreats, they will, like any other poisonous terrestrial snake, dart at a pole; or, when out of the water, they attempt to bite every object near them, even turning round to wound their own bodies. They cannot endure captivity, dying in the course of two or three days, even when kept in capacious tanks.

"That they live to a great age may be inferred from the circumstance that we find relatively very large examples of almost every species, but that such examples are very scarce. Now, as they have very formidable and very numerous enemies in the sea-eagles, (Haliäetus), in the sharks, and other large raptatorial fishes, it appears to me to be a just conclusion that, if sea-snakes of large dimensions were more numerous than they are, they would, in spite of those enemies, arrive at that size in a shorter period than that which we assume as necessary for their growth. The greatest size, however, to which some species attain, according to positive observation, is about twelve feet, and, therefore, far short of the statements as to the length of the so-called 'sea-serpents.' The large examples will measure eight feet."

THE COBRA (*Naja tripudians*).

FAMILY XXXVI.—ATRACTASPIDIDÆ.

The few species belonging to the genus Atractaspis are only to be found in the west and south of Africa; Atractaspis irregularis was found at Pungo Andongo, in Angola, by Dr. Welwitsch; and another species (A. corpulentus) is from Liberia.

FAMILY XXXVII.—DENDRASPIDIDÆ.

This family contains but a single genus, Dendraspis, and all the species known are from tropical Africa; D. polylepis is described by Dr. Günther from the Zambesi, where it was found by Dr. Kirk. Another species (D. welwitschii) was found by Dr. Welwitsch, the well-known botanist and traveller, at Mossamedes, in Angola. D. jamesonii is from Liberia, and D. angusticeps is from the Gaboon.

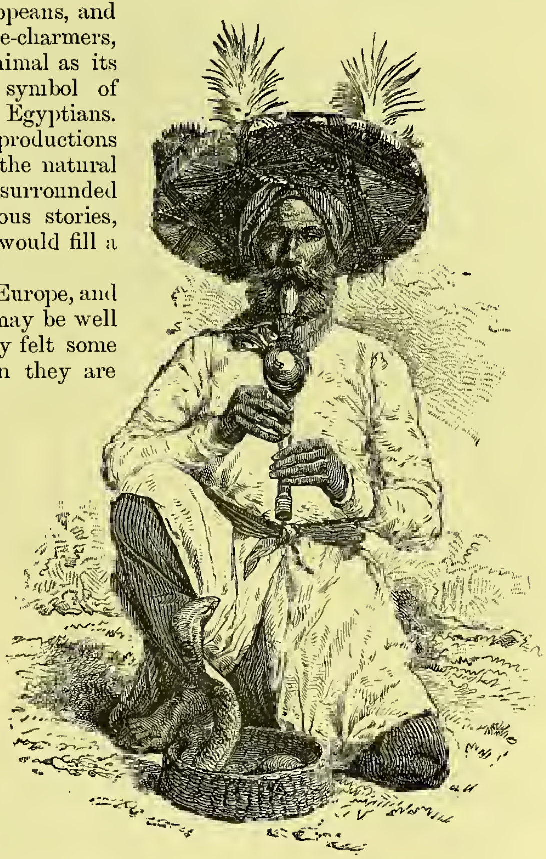
FAMILY XXXVIII.—ELAPIDÆ.

This is the last order of venomous colubrine snakes. It contains over a hundred species, to be found over the tropical parts of the whole world; but the species abound in Australia, and some of them are among the most venomous of the poisonous snakes. Their tail is conical and tapering.

The Cobra (*Naja tripudians*) is one of the best known. It is widely spread over India, and, unfortunately, only too common all over the continent of the Indian region. However, it is by no means confined to the continent and Ceylon, being found in a number of the larger islands of the Archipelago. It extends eastwards to the Sutlej, and westwards to the Chinese island of Chusan. Singularly, it has never been observed by Mr. Hodgson in the Valley of Nepaul, but occurs in different parts of the Himalayas, reaching an altitude of 8,000 feet in Sikkim. It attains to the length of five feet, feeding on small mammals and birds, on lizards, frogs, toads, and fishes. In order to obtain its prey it occasionally climbs trees or the roofs of huts. It is an expert swimmer, and is sometimes found at a considerable distance out at sea. It is more a nocturnal animal than a diurnal one, and it is ovo-viviparous. Its chief enemies are the jungle-fowl, which destroy the young brood, and the herpestes, or ichneumons, which will attack and master the largest cobra. In districts where the cobras or other venomous snakes have too much increased in number, the most efficient way of destroying them is to protect their natural enemies.

This, the most common venomous snake of India, is so much an object of dread to the natives, of wonder to the Europeans, and of profit to the numerous itinerant snake-charmers, that it has become as celebrated an animal as its cousin, the Naja haje, which was a symbol of female divinity among the ancient Egyptians. Almost every writer on the natural productions of the East Indies has contributed to the natural history of the snake, which has been surrounded by such a number of evidently fabulous stories, that their repetition and contradiction would fill a volume.

This snake is frequently brought to Europe, and will live in captivity for years. Two may be well kept together, and it appears as if they felt some attachment for each other: for when they are excited by having food brought into their cage, or by some other incident, they will frequently fight each other, raising the anterior part of the body, spreading the hood, and darting as if to bite, but always carefully avoiding to wound. When, however, a third individual or any other snake is brought into the same cage, they attack and kill it. They feed more frequently at dusk and during the night than in the daytime; they drink often and much.


HINDOO SERPENT CHARMER.

The cobra poison affects the whole system in a very short time; comparatively few are the cases where the person bitten escaped death without the timely application of remedies; and only too frequently the psychical and physical health of the unfortunate individual remains for a long time affected, and he suffers periodical returns of most painful symptoms.

The Egyptian Cobra (*N. haje*) is the species so often seen in Cairo.

Almost all the species of the genus Callophis are to be found in British India. They chiefly feed on non-venomous snakes, and would seem to be sluggish animals.

We now pass to the non-venomous snakes.

FAMILY XXXIX.—ACROCHORDIDÆ.

The Wart Snakes form a little group of some three or four species, only found in Singapore, Borneo, Southern India, and New Guinea. Their bodies are of moderate length, covered with small wart-like, tubercular, or spiny scales; their tail is short and prehensile. Acrochordus javanicus is a very rare snake, about eight feet in length, found in Java, Dr. Cantor compares its face to that of a thorough-bred bull-dog. It would seem to feed on fruit, but next to nothing is known about this remarkable form. It has been also found at Penang and at Singapore. Chersydrus granulatus is another species, thoroughly aquatic, as is indicated by its broad, compressed tail, which, however, differs greatly from that of the Hydrophides in not having the processes of the caudal vertebræ prolonged. It is more or less scarce, but found in the rivers and on the sea-coasts of numerous islands of the Archipelago, extending to New Guinea and the Philippines. It inhabits also the eastern coasts of Southern India and the Malayan Peninsula, and sometimes it may be seen three or four miles distant from the shore. Cantor found six eggs, with developed embryos, in a female which he dissected, the mother being nearly three feet long, the embryos $10\frac{7}{8}$ inches. In food and general habits this snake resembles the Hydrophides ; but it is not venomous, as has been stated by some writers.

FAMILY XL.—ERYCIDÆ.

The snakes of this family show great similarity to the pythons and boas with regard to their internal structure as well as to their external characters. But their tail is very short, not flexible, much less prehensile; and whilst the snakes of the families mentioned are more or less arboreal, frequenting marshy places with luxuriant vegetation, the Erycides inhabit dry, sandy, or stony plains, burrowing with the greatest facility below the surface, and entering crevices and holes in search of their prey, which consists of mice, lizards, and other burrowing snakes. Probably they are semi-nocturnal, and able to see in dark places as well as in the night. They are found in Northern Africa, in the islands of the Mediterranean, in Asia Minor, in the peninsula of Southern India, and probably in Arabia ; two species are known to have been brought from Sikkim.

The European Sand-snake (*Eryx jaculus*) inhabits Greece and parts of Northern Africa. It feeds on lizards and small animals.

Eryx johnii is a common species in the plains of the peninsula of Southern India. A large specimen, spotted all over with black, was brought from Sikkim by Messrs. von Schlagintweit, who fix the elevation at which it was captured at 9,800 feet above the level of the sea. No other instance of the occurrence of this snake at any considerable elevation is known. It is also found in Punjab. It is perfectly harmless, and never attempts to bite. It is frequently found in the possession of serpent-charmers, who mutilate the end of the short thick tail in such a manner that the scarred extremity somewhat resembles the form of the head. Such specimens are shown as "deadly two-headed snakes," and frequently brought to Europe. A specimen in the menagerie of the Zoological Society of London lived there for about eight years, and fed regularly on young mice. It always kept itself hidden below the gravel at the bottom of its cage. The species attains to a length of nearly four feet, the tail measuring four inches.

FAMILY XLI.—PYTHONIDÆ.

This family contains the Pythons, Boas, and Rock-snakes. They are chiefly tropical, though one species is found in California. They seem both to climb and to swim well. Here we find such large snakes as the two species of Indian Rock-snakes, and for size, only their African congeners and the American Eunectes murinus can be placed beside them. Their dimensions and their strength, however, have been, says Dr. Günther, much exaggerated : specimens of eighteen to twenty feet in length are very rare, although isolated statements of the occurrence of individuals which measured thirty feet are on record and worthy of credit. Rock-snakes, from fifteen to twenty feet long, have the thickness of a man's thigh, and will easily overpower a small deer, a sheep, or a good-sized dog. But although able to kill these animals, the width of their mouth is not so large that they can swallow one larger than a half-grown sheep. The way in which they seize and kill their prey is the same as that observed in numerous smaller snakes : after having seized their victim, they smother it by throwing several coils of the body over and around it. In swallowing they always commence with the head ; and as they live entirely on mammals and birds, the hairs and feathers offer a considerable impediment to the passage down the throat. The process of deglutition is therefore slow, but it would be much slower except for the great quantity of saliva discharged over the body of the victim. During the time of digestion, especially when the prey has been a somewhat large animal, the snake becomes very lazy ; it moves but slowly when disturbed, or defends itself with little vigour when attacked. At any other time the rock-snakes will fiercely defend themselves when they perceive that no retreat is left to them. Although individuals kept in captivity become tamer, the apparent tameness of specimens brought to Europe is much more a state of torpidity caused by the climate than an actual alteration of their naturally fierce temper. The rock-snakes must attain to a considerable age. A Python reticulatus lived in the menagerie of the Zoological Society of London for fifteen years. When brought to England, it was about eleven feet long, and in ten years it had attained to a length of twenty-one feet, after which no further growth could be observed. According to observations made by Bibron on young rock-snakes born in the Zoological Gardens in Paris, this specimen would have been about four years old at the time when it was eleven feet long; so that the growth is much quicker in the first period of life than afterwards. The males remain smaller than the females.

THE GUINEA ROCK SNAKE (*Python sebæ*).

The rock-snakes will propagate in captivity—the Indian P. molurus having bred in Paris, and the African P. sebæ in London. In both cases the eggs were incubated by the mother, and in the former successfully hatched. Fifteen eggs, of the size of those of a goose, were deposited on a 6th of May. The snake having collected them in a conical heap, coiled herself spirally round and on this heap, entirely covering the eggs, so that her head rested in the centre and at the top of the cone. The snake remained in this position until eight of the eggs were hatched on the 3rd of July.

As almost the same facts have been observed in another species from Africa, we may conclude that all the pythons in a free state take care of their progeny. An increase of the temperature has been observed between the coils of the snake in both cases, and it is probable that a higher degree of warmth is necessary for the development of the embryonic pythons than for that of other snakes.

FAMILY XLII.—AMBLYCEPHALIDÆ.

The Blunt-head Snakes are of small size, and their narrow mouth does not admit of their swallowing large animals. They feed on insects, and live in trees and bushes, or under roofs of huts. They are nocturnal animals. Two genera (Amblycephalus and Pareas) are known in British India, a third genus, Dipsadomorus, being confined to Sumatra. Leptognathus catesbyii is not very scarce at Bahia, and other species of this genus are to be found in Central and South America.

FAMILY XLIII.—LYCODONTIDÆ.

The genus Lycodon is entirely composed of Indian species. L. aulicus is one of the most common snakes of the Indian continent and of Ceylon. It does not extend northwards to China, and becomes scarcer on the coasts of the south-eastern parts of India. It occurs in only a few of the islands—in the Philippines and in Timor. It is not certain whether the Javan form is specifically the same. It attains to a length of more than two feet, the tail being one-sixth. It is one of the most formidable enemies of the skinks, which form almost its sole food, the fangs in front of its jaws being admirably adapted for piercing and making good its hold on the hard smooth scales with which those lizards are coated. It is of fierce habits and defends itself vigorously.

FAMILY XLIV.—SCYTALIDÆ.

The few species of this genus are chiefly confined to tropical America. Dr. Otho Wucherer says, writing of the snakes met with in the province of Bahia :—

"The Brazilian species belonging to this family are numerous. Of Scytale coronatum I have seen only the variety B. of Dr. Günther's catalogue. It is exceedingly common, and very remarkable for the different changes of coloration it undergoes by age. Young specimens are of a pale-pink colour; adults are of an almost uniform black colour above and white beneath. It lives, like all the members of this family, on lizards, chiefly on our most common species (*Trachycyclus marmoratus*). I have frequently had specimens of Scytale and Oxyrhopus alive for months; they are all of semi-nocturnal habits, and pursue their prey, not during the night, but at beginning of dusk or a short time before sunset. On seizing, they seldom crush their victims, unless these offer strong resistance; and considering how vigorous and tenacious of life lizards are, I have often been surprised at the little resistance they offer when caught even only by a leg. They seem paralysed. If they struggle, the snake quickly throws a coil or two over them; if not, they allow their pursuer, after a little while, to relinquish its hold and to seize them deliberately by the head. Is it that the snakes with grooved teeth are, after all, not quite innocuous, at least, for cold-blooded animals? I was once severely bitten by a Philodryas reinhardtii without feeling the slightest subsequent inconvenience."

FAMILY XLV.—DIPSADIDÆ.

This family contains a number of dark-coloured snakes, which live in trees and are nocturnal in their habits. They have short broad heads, and compressed elongate bodies. Some of them are found of from six to seven feet in length, and they all live on warm-blooded animals; but while some only attack birds, others will only attack mammals. A good many species are found in British India, but other species are to be met with in Africa, Australia, and tropical America. Dipsas trigonata is a common species in India, being found from the foot of the Himalayas to Bengal. It attains a length of about three feet, and feeds on mice. D. ceylonensis appears to take its place in Ceylon, and has the same habits.

FAMILY XLVI.—DRYIOPHIDÆ.

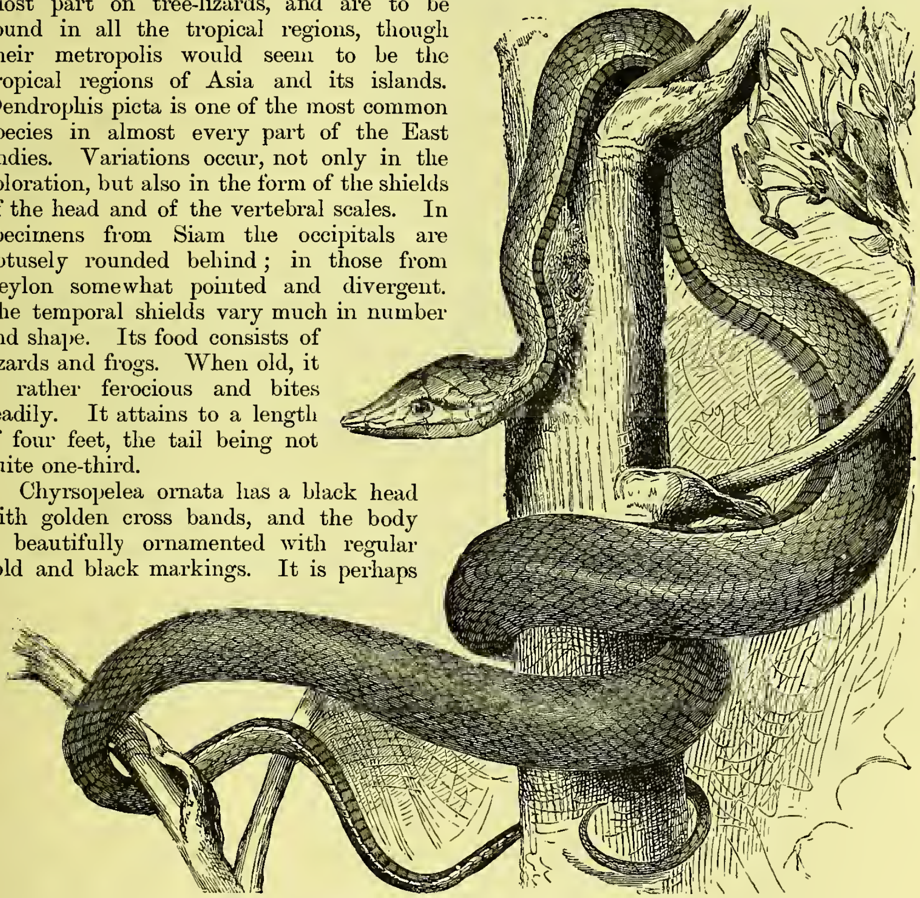
The Whip Snakes may be at once distinguished by their excessively slender body, which has been compared to the cord of a whip; by their prevalent green colour, with two white stripes on the belly; by the horizontal pupil of their eyes, indicative of their nocturnal habits; and, finally, by their dentition. Tropidococcyx alone approaches the Psammophides by a stouter habit. Their movements are awkward on the flat ground, but extremely graceful and rapid in their natural haunts among the branches of trees. Whilst they retain their hold with a few coils of the tail, their body enables them to reach a distant branch, or to shoot forth to seize a remote prey, as birds, lizards, &c. They are numerous almost everywhere between the tropics.

Tragops prasinus is very common in the East Indian archipelago and the western half of the continent from Bengal to China, though apparently not found in the peninsula of Southern India or Ceylon. Motley and Dillwyn say that it haunts the thicker parts of the jungle where there is much low wood, and that it is very active. From its long and graceful form, and the beauty of its colours, its movements are very elegant. Old examples are very ferocious; they prey on birds, lizards, frogs, and, when young, on insects. They attain to a length of more than seven feet, the tail being rather more than one-third.

These whip snakes are not to be found in Australia, but some species are found on the west coast of Africa, and two of the genus Langaha are found in Madagascar. Dr. Wucherer found two species (*D. argentea* and *D. acuminata)* of the genus Dryiophis in Brazil, of which the former seems to be very scarce, whereas the latter is exceedingly common. He repeatedly tried to keep live specimens in confinement, but they all soon perished, after incessant disquietude, without ever taking food of any kind.

FAMILY XLVII.—DENDROPHIDÆ.

The true Tree Snakes are all diurnal, living almost exclusively in trees, feeding for the most part on tree-lizards, and are to be found in all the tropical regions, though their metropolis would seem to be the tropical regions of Asia and its islands. Dendrophis picta is one of the most common species in almost every part of the East Indies. Variations occur, not only in the coloration, but also in the form of the shields of the head and of the vertebral scales. In specimens from Siam the occipitals are obtusely rounded behind; in those from Ceylon somewhat pointed and divergent. The temporal shields vary much in number and shape. Its food consists of lizards and frogs. When old, it is rather ferocious and bites readily. It attains to a length of four feet, the tail being not quite one-third.



TREE SNAKE (*Oxybelis fulgidus*).

Chyrsopelea ornata has a black head with golden cross bands, and the body is beautifully ornamented with regular gold and black markings. It is perhaps the most beautiful of all the snakes, and is widely spread over the tropical region of Asia. It has a wide geographical range on the continent as well as in the archipelago; but it appears to be limited to the tropical parts, as it never has been found in China nor in the Himalayas, except from Khasya. It attains to a length of more than four feet, the tail being one-fourth or rather more. Cantor says that it is but seldom seen in trees; that it is more frequently found on the ground, in the grass, watching for lizards and frogs; that it differs from other tree-snakes in its being without the power of compressing and expanding the anterior part of the body, and in its gentleness. Dillwyn, on the other hand, describes the capture of one, clinging in a most extraordinary manner upon the trunk of a large tree, head downwards, and without any visible means of supporting itself. When it came down it climbed up another small tree with wonderful speed.

Gonyosoma oxycephalum occurs in many of the large East Indian Islands. Specimens are described eighty-two inches long, the tail measuring nineteen inches. It is exceedingly strong and fierce, defending itself ferociously when attacked. It raises nearly the anterior third of its body vertically from the ground before it strikes. The form and colour of the body clearly indicate its thoroughly arboreal habits.

FAMILY XLVIII.—RACHIODONTIDÆ.

This family is founded for a very remarkable snake (*Rachiodon scaber*), from South Africa, which lives upon birds' eggs; these, "from the almost edentulous state of the jaws, glide along the mouth nearly unbroken, and it is not until they have reached the gullet, and the mouth is closed and prevents the escape of the nutritious matter, that the shell is exposed to instruments adapted to its perforation. The shell having been sawn open longitudinally by the vertebral teeth, the eggs are crushed by the contraction of the gullet and carried to the stomach."

FAMILY XLIX.—PSAMMOPHIDÆ.

The Desert Snakes are a small group, found chiefly in tropical Africa. Some of them are very slender in form, but others are of a stouter habit. They frequent plains, living on the ground. Some species of Psammophis are to be found in West Africa, in Calcutta, and in Persia. Cœlopeltis lacertinus is peculiar to North Africa, and is even said to have been found in the South of Europe.

FAMILY XLX.—HOMALOPSIDÆ.

The snakes of this family are thoroughly freshwater forms, and are only occasionally found on the land; several of them even enter the sea, and in several points of their organisation approach the truly marine snakes, with which they have been associated in Gray's system. They may easily be recognised by the position of the nostrils on the top of the snout, which enables them to breathe by raising but a very small part of their head out of the water. It is the same arrangement as that in crocodiles, sea-snakes, and other aquatic animals. Many have a distinctly prehensile tail, by means of which they hold on to projecting objects. Their food consists entirely of fish, and, in a few species, of crustacea also. All of them appear to be viviparous, and the act of parturition is performed in the water. They do not grow to any considerable size, are of a gentle disposition, and their bite would be by no means dangerous. They will not feed in captivity, and therefore die after a short time.

Cerberus rhynchops has a wide geographical range, as it inhabits not only the large islands of the East Indian Archipelago, but also Ceylon, the peninsula of India, Bengal, and Malayan Peninsula, and Siam. It is not known whether it occurs far inland. According to Cantor, it is numerous in the Malayan countries in rivers and estuaries, and occasionally along the sea-coast. Its usual size is between two and three feet, the tail being one-fifth of the total length; but it attains nearly four feet. The female brings forth eight living young, seven inches and a half in length.

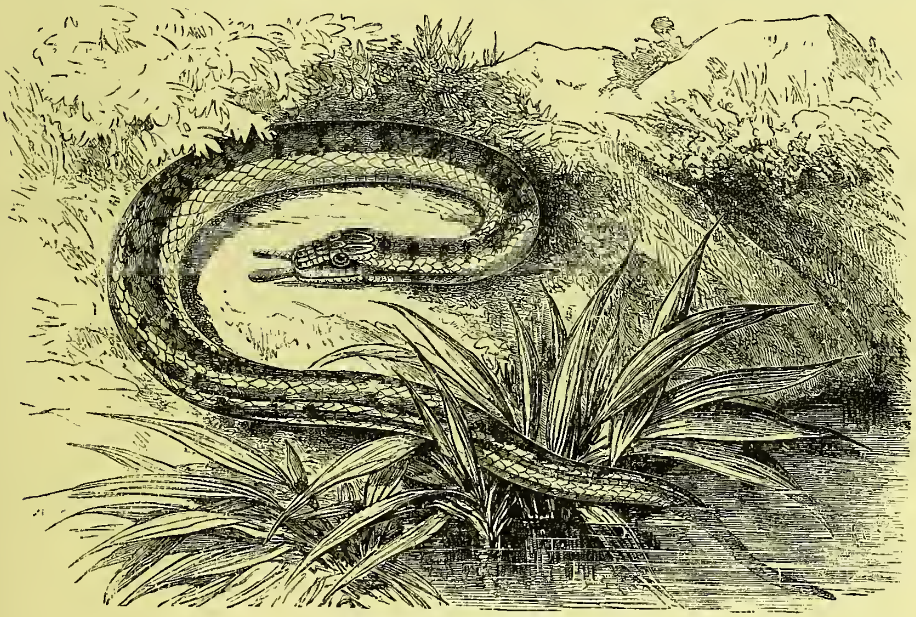
The Mutta Pam (*Hypsirhina enhydris*) is found in most parts of the East Indies, also in China and Bengal. It attains a length of twenty-eight inches. Dr. Cantor says: "Numbers of this species may be seen in rivers, as well as in irrigated fields and estuaries, preying upon fishes, which, however, it refuses in a state of captivity. It is of timid and peaceful habits. A large female, after having been confined upwards of six months in a glass vessel filled with water, brought forth eleven young ones. During the process she lay motionless at the bottom of the vessel; the anterior part of the abdomen was retracted towards the vertebral column, while the muscles of the posterior part were in activity. Shortly after parturition she expired, under a few spasmodic movements; and also two of the young ones died in the course of about two hours, after having, like the rest, shed the integuments. In length they varied from six inches to six inches and two-eighths. The living nine presented a most singular appearance; they remained a little way below the surface of the water, coiling themselves round the body of an adult male which was also kept in the vessel, occasionally lifting their heads above the surface to breathe, at the same time resisting the efforts of the senior to free himself. Fishes and aquatic insects were refused, in consequence of which the young ones expired from inanition in the course of less than two months."

Herpeton (Homalopsis) tentaculatum is a very strange form, found in Siam. The snout terminates in two flexible tentacles, or feelers, covered with scales. For more than half a century but one specimen was known. It is an aquatic species, like all the other snakes of this family. Its feelers are probably employed as organs of touch.

The species of Helicops are from America; and a species each of Limnophis and Neusterophis have been found in Western Africa.

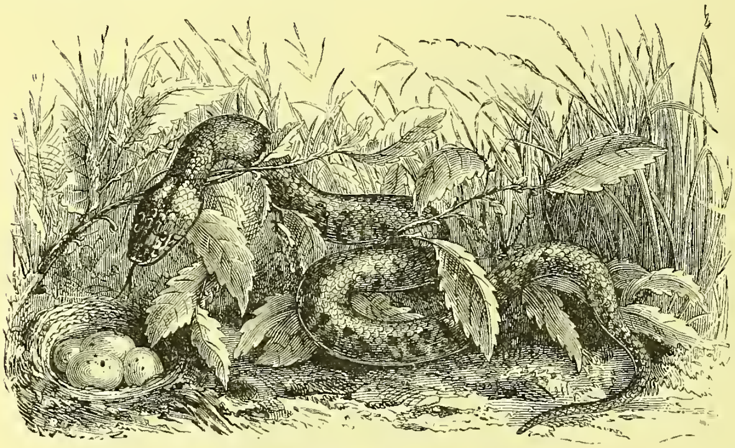
FAMILY LI.—COLUBRIDÆ.

The family of the Colubrine Snakes is a very large one, numbering over 270 species. These species are found all over the world, and reach the northern limit of serpents. In Australia, however, but very few species of this family are to be met with. This family is divided by Dr. Günther into four sub-families. 1. The Coronellinæ. These are colubride snakes of small size, with smooth scales, which generally are disposed in thirteen, fifteen, or seventeen series; some of them approach in general habit the Calamaridæ, whilst others have a more slender body and even angulated ventral shields. They live on the ground, and are generally of not brilliant coloration; only a few which frequent grassy plains are of a bright green colour. 2. The Colubrinæ. These snakes form, as it were, the nucleus of the whole family, or, rather, of the whole sub-order of innocuous snakes; they are typical forms, not characterised by the excessive development of some particular organ, but by the fairness of the proportions of all parts. Yet some of them have a more slender body than others which always live on the ground They are land-snakes, but swim well when driven into the water, or climb when in search of food. Their scales form never less than fifteen series, generally more. Their teeth are numerous, sub-equal in size, except in the genus Yamenis. They are of moderate or rather large size. 3. The Dryadinæ. The form of these snakes is elongate and somewhat compressed, indicating their climbing propensities. They have the body not so excessively slender as the true tree-snakes, to which they lead off. They are much more numerous in the New World than in the Old, and only a few genera are found in British India. Green is very frequently the ground colour in this group. 4. The Natricinæ. These snakes are generally not elongate or compressed, and the number of their ventral shields is considerably less than 200. All the Indian forms have keeled scales. They freely enter the water in pursuit of their food, which consists chiefly of frogs and fishes. All the snakes of the preceding groups overpower their prey by throwing some coils of the body round and over it, and commence to swallow it only after it has been smothered or at least exhausted; but the Natricines swallow their prey immediately after they have seized it. The genus Tropidophis leads off to the true fresh-water snakes or Homalopsides, the Indian species of which are distinguished by their grooved posterior tooth.



WATER SNAKE (*Herpéton tentaculatum*).

Some eighteen species of these sub-families are to be found in Europe. Coluber elaphis is the largest of these, growing to a length of five feet. In Southern Italy it is very common. The Ringed Snake (*Tropidonotus natrix*) is the most common European snake. It is found in England (not in Ireland); it also extends to Sweden and North Russia. It is said to be eaten in the South of France. It is truly oviparous, depositing its eggs a considerable time before the young ones are hatched, and leaving them to be developed by the heat of the sun or of some dung heap. The eggs are often connected together by a glutinous matter, and are from sixteen to twenty in number. Towards the end of autumn the ringed snake commences to hibernate, resorting to some sheltered spot near the roots of a tree or under a hedge, where they may be found sometimes in considerable numbers throughout all the inclement season tightly coiled together. With the first return of warm weather they come forth to active life. It is said to be easily tamed. Dr. Thomas Bell had one which could distinguish him from out of a group of persons, and which, when let out of its box, would immediately come to him and crawl under the sleeve of his coat, where it would lie perfectly still and enjoy the warmth. It would come to the Doctor every morning at his breakfast time for a draught of milk. It would fly from strangers, and hiss if they meddled with it.


THE RINGED SNAKE (*Tropidonotus natrix*).

It has often been introduced into Ireland, but such specimens are very speedily destroyed. The Irish climate would without doubt suit it, but the prejudice against such creatures is in Ireland very great, and the experiments made to introduce them into that country are not likely to meet with success. Another species, T. viperinus, is often mistaken on the Continent for the common viper.

The Indian Rat Snake (*Ptyas mucosus*) is one of the most common species on the continent of Asia and in Ceylon. It is scarce in the Archipelago, as its occurrence has been recorded in Java only; on the other hand it is not rare in Chusan and Formosa. In the Himalayas it ascends to only 5,240 feet above the level of the sea. It is a powerful snake, attaining to a length of seven feet, the tail being one-third or rather more. Its food consists of mammals, birds, and frogs. It frequently enters the dwellings of man in search of mice, rats, and young fowls. It is of fierce habits, always ready to bite; and old examples brought to Europe never become tame. Cantor says that it utters, when irritated, a peculiar diminuendo sound, not unlike that produced by a gently-struck tuning-fork.

FAMILY LII.—OLIGODONTIDÆ.

The Oligodons are essentially tropical snakes, nearly all of which are found in Asia, but a few species of the genus Teleolepis are found in America. Dr. Günther describes twelve species of Oligodon and sixteen species of Simotes from British India.

FAMILY LIII.—CALAMARIIDÆ.

The Dwarf Snakes are found in the warm regions of both hemispheres. They are very small, measuring between twelve and twenty-four inches in length. They are always found on the ground, beneath stones, fallen trees, or turf. Their diminutive size, narrow cleft of the mouth, and very limited capability of extending the skin of the throat and trunk, prevent them from attacking other reptiles, and their food appears to consist chiefly of insects and worms. More frequently they themselves fall an easy prey to other snakes, especially to the Bungari and Callophides, which inhabit the same localities. They are very gentle and never attempt to bite.

FAMILY LIV.—UROPELTIDÆ.

The Rough-tails form a little family of some twenty species, consisting of forms which, from the simplicity of the shields of their head, from their scales, their short tails, and their but little dilatable mouth, bear some resemblance to the Typhlopes. They also, like the Typhlopes, live under ground—their conical head, followed by a generally very stout neck, their rigid body, and, above all, their short, strong, and posteriorly shielded tail, being admirably adapted for burrowing. The species are very similar to one another.

The species do not attain to a considerable size, and hitherto they have been found only in Ceylon and in the peninsula of India. They are by no means scarce, but escape observation from their peculiar mode of life. In order to collect them it is necessary to dig for them to a depth of four feet. One of the most remarkable of the species (*Uropeltis grandis*) is distinguished by its dark brown colour shot with a bluish metallic lustre. It closely approaches the ordinary shape of the cobra, but its tail is most abruptly and flatly compressed, as though it had been severed by a knife. Sir James Emerson Tennant suggests that its form may have given rise to the fable of the strange transformation of the cobra di capello; the colour would seem to identify the two reptiles, but the head and mouth are no longer those of a serpent, and the disappearance of the tail might readily suggest the mutilation which the tradition asserts. The Singhalese folk lore here alluded to is to the effect that the cobra, every time it expends its poison, loses a joint of its tail, and eventually acquires a head which resembles that of a toad. According to Peters, and judging from one species, they are viviparous (*Rhinophis melanogaster*). They live on insects and worms.

FAMILY LV.—XENOPELTIDÆ.

The curious nocturnal flesh-eating snake that forms this family (Xenopeltis) has a flat depressed head, obtusely rounded in front; the eye small, with sub-vertical pupil; the body cylindrical; the tail tapering, and short. The circumference of the body is equal to the length of the tail, and one-tenth or one-eleventh of the total length. It is surrounded by fifteen longitudinal series of smooth, poreless, polished scales, those of the outer series being much larger than the others. Old specimens are uniform brown or blackish above and white below; young individuals have a white head, and this part is frequently of a lighter coloration even in older examples. Light lines run along the joining edges of the series of scales, but disappear nearly entirely with age. The cleft of the mouth is of moderate width, and the mandibles cannot be moved much from each other. There are forty closely-set teeth of equal size on each side of the upper jaw, and as many in the lower. The palatine teeth are rather stronger and more widely set, twenty-six in number. This snake attains to a length of three or four feet; it has been received from Penang and Singapore, from Gamboja, Sumatra, Java, Celebes, and Borneo. It is a nocturnal species and of fierce habits, feeding on small mammals, which it hunts for in their subterranean holes.

FAMILY LVI.—TORTRICIDÆ.

The Short-tails are a small family, the species of which are about six in number. Some are to be found in America. Cylindrophis pictus is not uncommon in Java, Borneo, and Singapore; while C. maculatus is found in Ceylon.

FAMILY LVII.—TYPHLOPIDÆ.

The family of Blind Snakes contains forms which are most remote from the true Ophidian type. They live under ground, their rigid body and short curved tail being adapted for burrowing. After showers of rain they occasionally appear above ground, and then they are very agile in their serpentine movements. The eye, which is scarcely visible in many species, can give to them only a general perception of light. They feed on worms and small insects; the tongue is forked, and, as in other snakes, frequently exserted. They are oviparous. The Blind Snake (*Typhlops vermicularis*) has been found in the Morea. It is about ten inches long.

The smallest species of snakes belong to this family, some of them being only half the size of a common earth-worm. They are to be found over the warmer regions of the earth.

CLASS IV.—BATRACHIA.

THE Frogs and Toads form the fourth class of the sub-kingdom of the vertebrates. The batrachians, like the reptiles, are cold-blooded animals, but they are distinguished from all the members of that class by the fact that at one period or another of their existence they breathe by means of gills, and respiration by means of gills is for the most part a respiration under water. Many batrachians, indeed, on assuming their adult form, breathe by means of lungs; but others breathe during all their existence by means of gills. Now, this alteration in the manner in which respiration is in some species carried on indicates another most marked fact; not, however, without exceptions in the life history of these batrachia; that is, that they pass from a gill-bearing to a lung-bearing stage; and this changing of form is known as their metamorphosis. When a "tadpole" changes into a "frog" we have an example of this change of form (metamorphosis).

This class, then, may be shortly described as consisting of animals with red, cold blood, with persistent or deciduous gills, and for the most part undergoing a metamorphosis.

THE TEGUMENTARY SYSTEM is rather characteristic: the skin is generally smooth glutinous, and clammy. It lies loosely on the body, and is often covered with a thin, colourless, outer layer (epidermis). It often contains pit-like glands, which secrete sometimes an acrid fluid, which is often of a disagreeable garlicky odour. Little depressions in the skin of the back are to be found in the female Pipa, and these act as marsupial pouches, in each of which an egg is placed by the male. In Nototrema marsupiatum there is in the female one large dorsal pouch which receives many eggs. In some a few thin colourless scales are to be met with concealed amongst the folds of skin.

In some of the American Newts (Plestiodon) the small scales present a reticulated appearance. In some of the toads, the tubercles on the back form a horny spine surrounded by a row of little ones; in others, small horn-like spines are developed from the skin of the upper eyelids. Pigment cells are often developed under the skin. The Common Tree Frog (*Hyla viridis*) has two kinds of pigment-cells beneath its skin, which are essentially different, and one of them consists of two sub-divisions. The one kind is irregularly polyhedral and filled with gold-yellow pigment granules. They never change their form. The cells of the other kind are starred, or polyhedral of variable form; one class of these is black, the other light-brown. The difference of colour depends upon the mass of the contained pigment-molecules, which singly are light-brown. The brown pigment-cells exhibit interference-colours that belong to the third Newtonian system of rings. The black pigment-cells show here and there a shade of blue. The yellow pigment-cells are placed the deepest below the cuticle. The brown pigment-cells in particular places have long anastomosing processes, and under different circumstances of excitement the pigment-granules are caused to pass from the processes, which then contain only a fluid on which the interference-colours depend. Thus, the change of colour arises from the variable quantity of the brown molecules in the more superficial layer of cells, which, on the one hand, allows of a greater or less transparency for the yellow cells below them to be seen, and on the other, a quantity of fluid, more or less unmixed with pigment-molecules, for the production of the interference-colours.

THE OSSEOUS SYSTEM is by no means so well developed as in the previous class. In some (Cæcilia), the individual vertebræ are connected together by conical-shaped surfaces, the intervals between which are filled with a soft substance (the remains of the chorda dorsalis), while in some of the higher members of the class the vertebræ are even joined together by a sort of a ball and socket joint (the ball is in front in the land salamanders and Pipa, while it is in the rear of the vertebræ in most frogs and toads). There are no true ribs to be met with in this class, but peculiar horny developments (processes) from either side of some of the vertebræ, to a certain extent supply their places. The number of the vertebræ varies greatly; there are more than a hundred in some of the sirens, and not more than ten in some of the frogs, and this seems reduced to seven in Pipa. Very few of this class are altogether destitute of limbs, but these are quite wanting in Cæcilia, and but feebly developed in some of the sirens, proteus, &c. The skull is articulated to the backbone by means of two long protuberances (condyles). In the higher forms the bones of the skull are ossified; the skull is of a broad, flat form, and one is at once struck by the immensely large openings for the eyes (orbits). The bones forming the upper jaw and the palate bones unite to form a broad arch, which is intimately attached to the skull. The lower jaw is articulated (jointed) to a bony process which often projects backwards from the skull, enabling the mouth to open very widely. In some, as the toads, there are no teeth, but generally these are present, though small in size. They are conical in shape. Sometimes they present the appearance of perpendicular plates, but they act the part rather of seizing and holding than of dividing or masticating the food.

The Alimentary System.—In the Batrachians, as in most of the reptiles, the stomach and alimentary canal are contained in the same general cavity with the organs for the circulation of the blood. In some, the mouth gives passage not only to the food on which the animal lives, but also to the water which contains the air by means of which it breathes, there being no opening for nostrils in this order. In some of the male frogs, the side walls of the mouth, or the portion under the tongue, are found expanded into pouches. These receive air, and are concerned in the production of sound. The tongue is especially small in the water-newts, but is in this order often very large. It is, in most batrachia, attached to the floor of the mouth, with its free border (tip) directed backward. This free portion can, in some, be raised and thrown out of the mouth, as is well seen in some toads, and these movements are executed often so quickly as to be scarcely followed by the eye. The tongue is moistened by a sticky saliva. In most frogs the free part of the tongue is bifid. The gullet (œsophagus) is short and wide, and its delicate cellular lining (epithelium) is often provided with wonderfully minute eyelash-like bodies (cilia). The stomach is either long, cylindrical, and nearly straight (as in Proteus, Siren), or bends a little (as in Salamandra), or is pear-shaped (as in the frog). The intestinal canal, although very simple in some of the batrachia, is wonderfully rolled up into a double series of spiral coils in the larval stages of the frogs. As a rule, the intestine is short, and with few coils in the adult forms. There is no cæcum to be met with in the order, the small intestine sometimes terminating quite abruptly in the large intestine. The terminal orifice of the intestine (arched in the reptiles) never opens directly upon the exterior of the body, but always into a cavity (cloacum) common to it and the urinary orifices. The shape of the liver varies a good deal. It presents the form of a long right lobe, with a very small left lobe in the Sirens. In the newts the liver is rather short and broad. In the frog it is well divided into two lobes, and the left lobe itself is even subdivided. A gall-bladder seems to be always present. The pancreas seems to vary very much in form, being quite ramified in Menobranchus; a long slender gland in Menopoma; rather broader in Triton; in the salamander it is again long and narrow; in the frog it is flattened; while in some species of Cæcelia it is thick and pyramidal.

The Blood System.—The little red corpuscles (discs) found in the blood of vertebrates attain a large size in the animals of this order, being almost visible to the unassisted vision in Siren lacertina. Blood drawn from a living batrachian is of a purplish-red colour, and the serum of the blood is of a light-yellow hue. The minute ramifications of the veins (capillaries) are of large size in the batrachian, and hence, if one selects, for microscopical observation, a semi-transparent portion of the tissues of any one species, the web between the toes of a frog, for example, or the tail of a tadpole, the currents of the blood flowing constantly from the arteries to the veins can be easily demonstrated. There are but few valves in the veins of the batrachia, but it is interesting to note that the thin coat of muscle that surrounds them is formed of what is known as "striped fibre," and the veins are thus, in certain parts of the body, able to pulsate regularly, quite independently of the pulsations of the heart. The heart consists of a right and left auricle, and a single ventricle, which latter has a muscular appendage (arterial bulb) at the origin of the arteries. Branchiæ, or gills, which are filamentous structures, exercising a respiratory function, are present during a longer or shorter period in all batrachia. In some, two sets of these gills are developed; one is an external set, and whatever their form or structure, their duration is but brief. On their first appearance (*e.g.*, in the tadpole), they are to be seen coated with very minute beautiful waving whip-lash-like bodies (cilia). The second set is an internal one, developed subsequently to and retained in most longer than the ciliated set. The batrachia, which, on passing to their adult state, lose the external gills, are called caducibranchiates; those which retain them more or less throughout their life are called perennibranchiates. In the tadpole of the common frog, when first it escapes from the egg, the external gills can be distinctly seen, but about the fourth day of its existence they begin to wither, and they are absorbed by the seventh day. After this it carries on its respiration partly by a series of internal gills, which more resemble those of fishes than the external gills of the Proteus; but from a very early period of the tadpole's existence there are lungs which even now seem to be used as aids to respiration, and as Dr. R. M'Donnell has pointed out, as the anterior or fore-legs of the tadpole, in process of growth, come forward, they press on these gills, retarding by their pressure the circulation through them, and gradually prepare the way for, the more complete lung-respiration of the adult forms. And here it may be called to mind that W. Edwards' experiments point out that when there is no very great energy of respiration required by the frog, its very skin may exhale quite enough of carbon dioxide and absorb sufficient of oxygen for its languid life, and under these conditions, even without gills, the frog can live under water, provided the water is neither too cold nor too warm.

As to the shape of the lungs in the Batrachia, it will suffice to mention that they are generally long and narrow in the tailed species, while in the tailless form they are broad, with longish bronchial tubes and a much more extensive respiratory surface than in the former group. They are suspended in a cavity common to the chest and abdomen, and are filled with air by acts of swallowing, the act of inspiration not being helped by the ribs or a diaphragm. The walls of the lungs are so elastic that the act of expiration is quite easily effected. Batrachians, as well as some lizards and snakes, can inflate their lungs under the influence of fear. In many of the tailless Batrachians, the larynx, especially in the males, is well developed. In some, above and below the vocal cords, there will be found a mucous pouch. Several special muscles act on the larynx and assist in making the many strange noises peculiar to the different species. Some are quite mute (Pipa), others (Rana) make most discordant croakings. Sir Joseph Hooker tells us of a species of Leptcha that he found in the Himalayas, that "except for the occasional hooting of an owl, the nights were profoundly still during several hours after dark, the cicadas at that season not ascending so high on the mountain. A dense mist shrouded everything, and the rain pattered on the leaves of our hut. At midnight a tree-frog ('Simook') broke the silence with his curious metallic clack, and others quickly joined the chorus, keeping up the strange music till morning. Like many Batrachians, this has a voice singularly unlike that of any other organised creature. The cries of beasts, birds, and insects are all explicable to our senses, and we can recognise most of them as belonging to such and such an order of animal; but the voices of many frogs are like nothing else, and allied species utter totally dissimilar noises. In some, as this, the sound is like the concussion of metals; in others, of the vibration of wires or cords; anything but the natural effects of lungs, larynx, and muscles."

Batrachia, with very few exceptions, are oviparous, but a few among the tailed forms are viviparous (Salamandra), thus enabling the young to avoid the necessity of an aquatic life. As the larvæ of the tailed forms develop, their front legs are the first to appear; while exactly the contrary is the case with the limbs of the tailless forms.

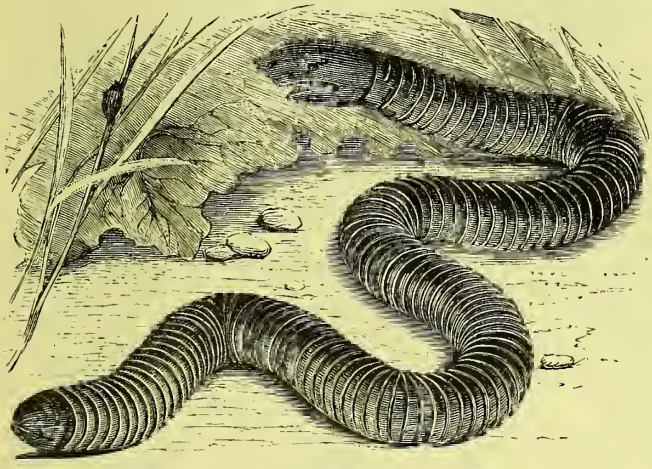
The class Batrachia may be thus subdivided :—

Wanting feet, body vermiform	Order I.—Pseudophidia.
Having feet, adult with tail	„ II.—Urodela.
„ „ „ without tail	„ III.—Anura.

ORDER I.—PSEUDOPHIDIA.

The few Batrachians to be met with in this order have their bodies long and cylindrical. They have no limbs, and are externally very like the common earth-worm. According to Dr. Günther, these Batrachians have even been placed by the early zoologists among the snakes. A tail is absent or extremely short. The skin is smooth and viscous, forming numerous annular folds; transverse series of rudimentary scales are imbedded in these folds, especially in those of the posterior part of the body. Their eyes are rudimentary, more or less hidden beneath the skin.

They live constantly below ground, burrowing like worms. Their food appears to consist of earth and earth-worms. Their metamorphosis is less complete than in the two previous orders. The young do not live in the water, and have quite the external appearance of the old ones, but they are provided with short gills, which scarcely project from the gill-openings. Gills and gill-openings disappear at an early period, and the perfect animal has only one lung developed, the other remaining rudimentary, as in most of the snakes.



THE RINGED CÆCILIA.

FAMILY I.—CÆCILIADÆ.

The characters of the order will serve for those of this, the only family, which by some is divided into four genera, and contains about seventeen species. The species of the genus Cæcilia inhabit South America and Africa. Cæcilia compressicauda is interesting from the researches of Professor Peters, who had the opportunity of studying the habits and structure of some living specimens captured at Cayenne. Peters' researches indicate that the animals of this order begin their existence by breathing by means of external gills, then change these to internal gills, and finally replace these by true lungs. Cæcilia rostrata has been found by the writer at the Seychelles; it had been previously known only as inhabiting South America. The occurrence of an animal like this in two such widely separated regions is very interesting and noteworthy. For a long time it was looked for at Mahè in the rank vegetation on the sides of mountain streamlets, but in vain. An accident revealed their true habitat, under the roots of the plants of banana (*Musa*). By digging in the vicinity of a banana plantation, the spade every now and then would turn up one of these strange worm-like creatures, which, if they were not caught on the moment, at once disappeared in the loose earth. When captured they would perspire a viscid slime, which enabled them to wriggle easily out of one's grasp; and under a blazing sun it was a good morning's work to secure a bottle full of them. Cæcilia oxyura, which occurs in Malabar, is very like the last-mentioned species. Siphonops mexicanus is found in Mexico, and another species of the genus in Brazil. The well-known Javanese Cæcilia (*Epicrium glutinosum*) is found in Java. In Southern India and Ceylon it grows to a length of from thirteen to fifteen inches. Rhinatrema bivittatum is a native of Cayenne.

ORDER II.—URODELA.

In this order the species have an elongated, lizard-like body, terminating in a tail, with four or two limbs. It contains about a hundred species. In some the gills are persistent throughout life (*Perennibranchiata*); in others they fall off about the adult period (*Caducibranchiata*). The entire order is confined to the temperate regions of the northern hemispheres; and only recently one species has been discovered extending into the Indian region proper. Another is believed to inhabit a part of China, the fauna of which bears a thoroughly Indian character. There is no doubt but that by future researches in the Himalayas and in Formosa other additions will be made, although they must always be considered merely as outposts of the Palæarctic region.

FAMILY II.—SIRENIDÆ.

This family contains but two species, both natives of the Southern States of North America. They have a long body, with persistent gills, just behind which there are two very short feet, with three toes in the one species (*Siren lacertina*), and four toes in the other (*S. striata*). They feed on worms and insects, and were at one time thought to be only larval forms. They live either burrowing in the earth or in mud.

FAMILY III.—PROTEIDÆ.

Of the two species belonging to this family, one, the Proteus (*Proteus anguinus*), is only to be found in the subterranean waters of certain caverns in Illyria and Dalmatia. Its body is smooth, white, or of a rosy grey, with red gills; its tail is much compressed. There are four short limbs, the front with three, the hind with two toes. The head is triangular. The eyes are very small. It attains to a length of nearly a foot. There are many marked varieties. Mr. Cope makes four species.

At Adelsburg, in the Duchy of Carniola, belonging to Austria, there is one of the most splendid caverns in Europe; it is commonly known by the name of the Grotto of the Maddalena.

The whole of this part of the country consists of bold rocks and mountains, of limestone formation, full of subterranean caverns, containing lakes and vast reservoirs of water hundreds of feet beneath the surface, whence many rivers take their secret origin. These subterranean waters communicate with and supply a small lake in the celebrated cavern now alluded to: and it is in this lake, where the sun never enters, enclosed by barriers of piled-up rock, deep in the bowels of the earth, that the proteus is found reposing on the soft mud precipitated by the water and lining the rocky basin. It has also, though rarely, been noticed at Sittich, about thirty miles distant, thrown up from a subterraneous cavity.

The waters of the cavern at Adelsburg must not, however, be supposed to teem with these animals; their occurrence is uncertain, and depends on casual circumstances. According to Sir H. Davy, "they are seldom found in dry seasons, but after great rains they are often abundant;" and he adds: "I think it cannot be doubted that their natural residence is in an extensive, deep, subterranean lake, from which, in great floods, they sometimes are forced through the crevices of rocks into this place, where they are found; and it does not appear to me impossible, when the peculiar nature of the country is considered, that the same great cavity may furnish the individuals that have been found both at Adelsburg and Sittich."

The other species (*Menobranchus lateralis*) of this family is found inhabiting the great lakes of America and the Ohio and Alleghany Rivers. It is said to be nocturnal, grows to a length of about two feet, and feeds upon worms and insects. Its eyes are very small, and all its feet are four-toed.

FAMILY IV.—AMPHIUMIDÆ.

This family has also but two species, both found in America. It would belong to the second division of the order, for the gills are not permanent; but the gill-openings are only closed in the adult. They grow to a length of one foot and a half, and have four feet. In Amphiuma means these feet have each two toes; in the other species (*A. tridactylum*) there are three toes on each foot. They live in deep ditches and freshwater lakes.

FAMILY V.—MENOPOMIDÆ.

The geographical distribution of the two species of this family reminds one of that of the species of the second family, for one, the Mud Devil of the States (*Menopoma alleghaniensis*), is to be met with in many of the rivers of North America, where it sometimes attains a length of two feet. It is of a slaty colour, with dark spots; has an elongated thick body, with four feet; the hind feet have five toes each, and the two outer of these have large membranous fringes; the tail is compressed and shorter than the body; the eyes are small. The other species is the largest of all living batrachians. This, the Great Salamander (*Cryptobranchus japonicus*), is a native of Japan and China. It grows to a length of three feet; its head is flattened and oval; the gills soon disappear, and the gill-openings close up; the tail is short, flat, and provided with a crest. It is of a dark iron-brown colour, bestrewn with blackish spots. It is often to be seen living in the London Zoological Gardens.

THE TRITON CRISTATUS.

FAMILY VI. — SALAMANDRIDÆ.

This, the last family of this order, contains more than eighty species. In their perfect state their respiration is by means of lungs, but the larval forms breathe by means of gills. The eyes are well marked and have distinct eyelids. They have four feet, the anterior with four toes, and the posterior almost invariably with five. They are chiefly characteristic of the north temperate regions, though a few species extend towards the warmer regions. The larvæ live constantly in water, even when the adult forms thereof keep on the land. The external gills persist until the development of lung respiration. The fore limbs in the larvæ are developed earlier than the hinder. Of the numerous species we can select but a very few. Seven species of Triton are found in Europe, of which the Warty Newt (*Triton cristatus*) is perhaps the commonest species. It is not, however, so common in Great Britain as the next species.

The common Smooth Newt (*T. punctatus*) is found in almost every ditch and pond—especially in those in which the waters are clean—in considerable numbers; and affords food to the larger species just described, as well as to different kinds of fish. Its own food consists of small aquatic insects, both in their perfect and, especially, in their larval state, and of small aquatic worms and molluscs. They also rise to take gnats, &c., which settle on the surface of the water.

The reproduction and metamorphosis of this species differ very little from those of the former. I have observed that in depositing their eggs, they do not so constantly place them within a folded leaf, but frequently at the base of the leaves; in which situation I have very often observed the females in the act of placing them, and sometimes two, three, or four together. The changes which take place in the development of the embryo are similar to those in the former species.

In the month of June the young animals have in many cases lost their branchiæ by absorption, and very soon afterwards a great number of them, at least, quit the water, and remain on land. Many of the adults also become terrestrial soon after this period, creeping about amongst the herbage in the neighbourhood of the water, or in damp places, frequently concealing themselves amongst the roots of shrubs and plants, and sometimes even venturing into damp cellars. The males about this time lose the membranous crest and enlargement of the caudal web, which had distinguished them during the spring. The colours also of both sexes become more dull, and the male especially loses in a measure the bright and pleasing tints which characterise him during that season. The red tips to the crenations of the crest and tail are of course no longer seen, as these parts become absorbed; but the colour of the body is also more obscure, and the spots less distinct; the belly, which has been of a bright orange passing into red, is now paler and less vivid.

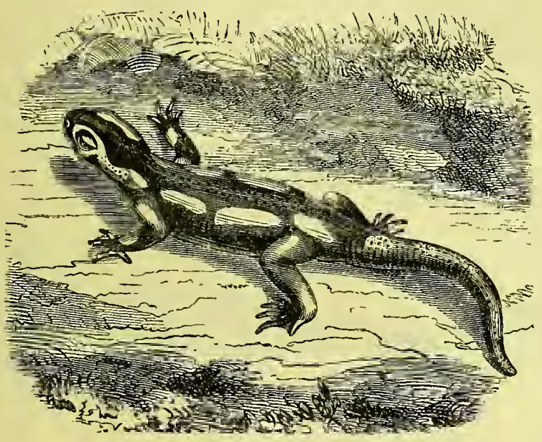
It is probable that the period when the young lose their branchiæ varies in some degree according to circumstances connected with temperature, food, and other causes; as they are sometimes taken with the branchiæ still remaining on them, when conspicuously larger than other individuals which have lost these organs. The growth of the young animals during the summer and autumn is very rapid; so that they attain nearly their adult size the first year. Very early in the winter the crest of the male begins to make its appearance, and by the beginning of the year it is conspicuous.

NEWTS.

The pretty Spotted Salamander (*Salamandra maculata*) inhabits the greater part of Central and Southern Europe. It grows to about six inches in length. The tail is not compressed, as in the newts, but rounded. It produces its young alive, betaking itself for that purpose to the water, but at other times is altogether terrestrial in its habits, preferring, however, situations where it can imbibe moisture through its numerous pores. The breeding season is from March to June. It feeds on insects, slugs, and earth-worms. The belief formerly prevalent that the salamander was able to resist the action of fire is, we need hardly say, quite unfounded.

All the species of the genus Amblystoma are natives of America. The Axolotl (*Amblystoma mexicanus*) is referred by some to a distinct genus—Siredon. On this subject Mr. W. H. Smith says: "While the axolotl has hitherto been referred to a distinct genus, yet the researches of Dumeril, Marsh, and Tegetmeier render it probable that it is only an immature form, and probably, as suggested by Cope, it, with some other species, belong to the genus Amblystoma. At the same time, it should be borne in mind that no one has ever seen a species of true axolotl, such as Siredon mexicanus, undergo metamorphosis, all the observations recorded on this point having been with Siredon lichenoides, which, soon after naming by Professor Baird, was suspected of being a larval form. Still further, in all the collections brought from Mexico not a single Amblystoma has ever been obtained south of the 26th parallel, while the axolotl inhabits the Lake of Mexico. Dumeril has also shown that the Siredons were capable of reproduction, while so far as our present knowledge goes, the metamorphosed Amblystoma is always barren. These facts leave still room for doubt as to whether these animals undergo transformation. And yet while no specimen has ever been observed showing a tendency to a change, their relation to an animal on which observations have been made is such as to render a metamorphosis in their case exceedingly probable under favourable conditions. In naming them here, the generic term, Siredon, though perhaps inappropriate, is retained where a better has not been given, because when the adult is discovered, it will probably be some already well-known salamander, and in the present state of science to assign them new designations would only add to the already burdensome list of synonyms. Also the characteristics of Siredon are still valuable as referring to the young.

The Red-backed Salamander of America (*Plethodon erythronotus*) is among the first seen in that country in spring, having been observed as early as the middle of April. It is found in moist, woody places, hiding under stones and old logs, and when discovered, if alone, it quickly disappears in the decayed wood, moss, or earth, but if accompanied by its young, neither it nor the little ones attempt to escape. It climbs up the large grasses, and is very frequently to be found curled up on herbs, and if disturbed can spring away by a sudden uncoiling. Its food appears to be small snails or molluscs, and when the young are found, as a rule they are accompanied by a parent, but are sometimes alone. Their little ones, as well as their eggs, occur under the moss and bark of decayed trees. The latter are found in bunches of from six to eleven each, and individually are about $\frac{3}{20}$ of an inch in diameter. The young are supplied with branchiæ, but lose them very early—that is, about three or four days after hatching. Dr. Günther mentions a species of this genus from Siam.

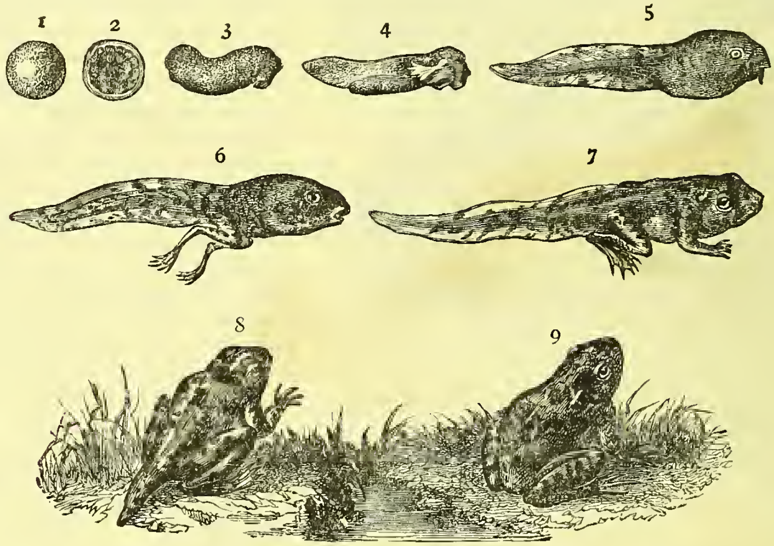


THE LAND SALAMANDER.

The Red Salamander (*Spelerpes ruber*) inhabits the United States east of the Rocky Mountains. It is found under stones in shallow water and marshes. When discovered in the former they seem to be alarmed, and endeavour to get away, but in the latter situation show no disposition to stir. They are apparently nocturnal animals, remaining in concealment during the day, and at night sallying forth in search of prey. Their food is mainly small worms, though Hallowell found in the stomach of one a coleopterous insect, and the tail and posterior limbs of a salamander, probably Plethodon niger, and they are themselves devoured by the American bittern, and doubtless many other animals in like manner prey upon them. In confinement they rarely leave the water in the day-time, but usually do so at night.

ORDER III.—ANURA.

The Tailless Batrachians, or the Frogs and Toads, have in their perfect condition a short, broad body, without a caudal appendage, and with four limbs, the posterior pair being much stronger and longer than the anterior, and specially suited for leaping or swimming or burrowing. Many species have a web between their toes, and the degree of its development between the hind toes in different species indicates their respective power of swimming. Such a membrane between the fore toes is found only in some of the climbing forms, which always have the extremities of the toes dilated into round disks. The food of these batrachians consists of insects and worms, and only the largest kinds feed on small vertebrates also. They seize their prey with the clammy tongue, either filliping it out of the mouth, as those do which have their tongue adherent in front and free behind, or only turning it out when that organ is nearly entirely attached to the bottom of the mouth. Teeth are never found in the lower jaw, which is a simple, feeble arch, and only a few species have a pair of tooth-like prominences near the middle. On the other hand, the upper jaw and the lower are very frequently armed with a series of feeble teeth, which in the largest species assist in seizing the food. The prey is swallowed entire.



DEVELOPMENT OF THE FROG.

1. Egg of frog. 2. The egg fecundated and surrounded by jelly. 3. First state of the tadpole. 4. Appearance of the breathing-gills. 5. Their development. 6. Formation of the hind feet. 7. Formation of the fore feet and decay of the gills. 8. Development of the lungs and reduction of the tail. 9. The perfect frog.

Moisture is as necessary for these batrachians as food and air; hence they are found only in damp places or in the neighbourhood of water; and when the hot season commences, batrachians living remote from water bury themselves deep enough in the ground to escape the drying influence of the atmosphere, and fall into a state of lethargy identical with the winter sleep of the species inhabiting colder climates. Their lungs consist of two capacious sacs, which may be so much expanded that the animal assumes nearly twice its natural volume. When they dive the lungs are emptied, and the respiration can remain interrupted for one or two hours, after which time the animal is compelled to rise to the surface in order to breathe. However, the necessity of breathing depends entirely on the energy of the other functions, as during hibernation or during the lethargy in the dry season the respiration is suspended for months.

The suspension of the vital functions of these batrachians, and their tenacity of life, has given rise to some fabulous tales. It has been proved that some of them will survive a lethargic state continued for years; but every attempt to revive the old stories of toads enclosed in coal-beds or rocks testifies to a lamentable ignorance of the merest elements of geology and physiology on the part of those who put forward such statements.

Many of these batrachians are endowed with a powerful voice, being provided with one or two membranaceous gular sacs. In the species which have two, one is situated at each side of the lower jaw, whilst in those having a single one it is placed between the branches of the mandible. In either case the vocal sac opens by two slits in the cavity of the mouth, and is filled with air from the lungs. These vocal sacs are peculiar to the male sex.

The skin is sometimes smooth, sometimes tubercular and glandular, the glands being either equally distributed over the whole surface of the animal, or aggregate. Such an aggregate gland is very frequently found above the tympanum, on each side of the neck, and having been compared with the parotid of the mammals, it has been termed parotoid; it is however merely a cuticular gland, and as it does not discharge its secretion into the cavity of the mouth, it has no reference whatever to the alimentary functions.

We have mentioned above that many of these batrachians live at some distance from water; all, however, as far as is known at present, enter it at the season of propagation. The males of many species may be externally distinguished by a rough swelling of their thumbs, or, as is the case in some American and Australian species, by short conical spurs on the thumb or in the sternal region. The males have also generally a distinctly more slender form than the females. The eggs are impregnated the moment they are deposited by the female in the water; during their passage through the oviduct they are surrounded with a gelatinous coat, which swells in the water and protects them from changes of temperature. The young ones, or tadpoles, as we have seen, have thick, black bodies without legs, terminating in a long, strong, compressed tail, which serves as an organ of locomotion in the water. They are true aquatic animals, breathing by gills, and having the same anatomical and physiological arrangement of the organs of circulation as fishes. The mouth is very narrow, and the jaws are armed with a hard, horny covering. Their food consists chiefly of living or decaying vegetables, but also of decomposing animal substances; and in accordance with this kind of food, so different from that taken by them after their metamorphosis, the intestinal canal is spirally contorted and much longer than in the perfect animal. In proportion as the gills are superseded by the lungs, which are gradually developed, the hind limbs, and, later, the fore limbs, sprout forth, whilst the tail is absorbed; the intestinal tract becomes shorter, dividing itself into stomach and small and large intestine.

FAMILY VII.—RHINOPHRYNIDÆ.

This family contains but a single species (*Rhinophrynus dorsalis*), with imperfect ears, a tongue free in the front, webbed toes. The male has two vocal cavities. It is bluish-grey, with yellow spots on the side and back, and is found in Mexico.

FAMILY VIII.—PHRYNISCIDÆ.

The Toads of this family have also imperfect ears, but their tongue is more or less elongate, and fixed in front; it is free behind, where it is entire. There are no neck glands, and, as in the previous family, the projections from the sacral vertebra are flattened. Phryniscus lævis, and the several other species of this genus, come from South America. Mr. Darwin writes:—"Amongst the batrachian reptiles I found only one little Toad (*Phryniscus nigricans*), which was most singular from its colour. If we imagine, first, that it had been steeped in the blackest ink, and then, when dry, allowed to crawl over a board freshly painted with the brightest vermilion, so as to colour the soles of its feet and parts of its stomach, a good idea of its appearance will be gained. If it had been an unnamed species, surely it ought to have been called Diabolicus, for it is a fit toad to preach in the ear of Eve. Instead of being nocturnal in its habits, as other toads are, and living in damp, obscure recesses, it crawls during the heat of the day about the dry sand-hillocks and arid plains, where not a single drop of water can be found. It must necessarily depend on the dew for its moisture; and this probably is absorbed by the skin, for it is known that these reptiles possess great powers of cutaneous absorption. At Maldonado I found one in a situation nearly as dry as at Bahia Blanca, and thinking to give it a great treat, carried it to a pool of water. Not only was the little animal unable to swim, but, I think without help it would soon have been drowned." Pseudophryne australis is a native of Swan River, first found in New South Wales by Mr. Joseph W. Wright. Henusus guttatum comes from Africa, and Micrhyla achatina has been found in Java.

FAMILY IX.—HYLAPLESIDÆ.

The five or six species belonging to this family are from tropical America. They are frog-like toads, with perfect ears, and no neck glands. The projections from the sacral vertebra are not flattened; the toes are all free and dilated at their ends. Hylaplesia tinctoria is a very common species from South America, being found at Bogota, Para, and Panama.

A pretty species (*H. picta*) is found in Brazil and Demerara, and a beautiful carmine coloured species (*H. speciosa*) has been found living 6,000 feet on the Andes of New Granada.

FAMILY X.—BUFONIDÆ.

This family contains nearly seventy species. They have the snout rounded or truncated; limbs rather short; teeth none; tongue elongate-ovate, entire, and free behind; parotids very distinct, swollen; skin more or less warty; openings of the Eustachian tubes of moderate width; fingers quite free; toes generally half webbed. The males have generally a single vocal sac, which is not visible externally.

Toads are found in almost every part of the tropical and temperate regions. Their repulsive appearance, nocturnal habits, and the fetid smell of their secretions, have rendered them objects of horror and superstition, although it is now almost universally known that they are most harmless, and are even useful creatures. They generally come forth from their hiding-places towards dark, in search of food, which consists of worms, larvæ, and slowly-moving insects; they also make their appearance after showers of rain, picking up the insects and larvæ which drop from trees. When attacked by man, or by an animal, they exude a milky fluid from large glands situated on each side of the neck, called parotid, and from numerous smaller glands with which their body is covered. This fluid can be ejected to a distance of a foot or more from the parotids; but, although of an offensive smell, it has no poisonous qualities, and will produce merely a slight redness on a delicate skin; if accidentally carried into the eye, it is however often followed by slight pain and inflammation of the conjunctiva. However, this fluid is an excellent protection to toads, as almost all animals feeding on Batrachia reject toads as food.

THE COMMON TOAD (*Bufo vulgaris*).

They live in damp, dark places, and enter the water only at the season of propagation. They are bad swimmers and leapers, their feet being short, with the interdigital membrane not well developed.

The European Toad (*Bufo vulgaris*), which is common in England, but not found in Ireland, extends from Western Europe, through the temperate parts of Central Asia, to China and Japan. Specimens have been collected in the Himalayas at altitudes of from 5,900 to 10,200 feet.

The Natter Jack Toad (*B. calamita*) is found in Ireland; also in many parts of Europe, and it occurs also in Tibet.

Pseudobufo subasper is from the East Indian Archipelago.

FAMILY XI.—ENGYSTOMIDÆ.

The toads of this family have no neck glands, and their tongue is fixed in front. There are upwards of thirty species known, and they seem spread over the African, South Asiatic, and Australian regions, some species being also found in South America. Dr. Günther thinks Diplopelma ornatum to be one of the smallest of the Indian batrachians. It is scarcely an inch long, and appears sometimes in great numbers after showers of rain in the month of November. Engystoma carolinense, and nearly all the other species of this genus, are from America. Breviceps verrucosus comes from South Africa; while Chelydobatrachus gouldii is from Western Australia.

FAMILY XII.—BOMBINATORIDÆ.

The frogs belonging to this family, though not a dozen in number, are interesting on account of their strange geographical distribution. They have very imperfect ears, and no neck glands. The tongue is fixed in front of the mouth ; sometimes the toes are webbed, sometimes free. The species are to be found in Europe, the southern portions of South America, and in New Zealand.

Pelobates fuscus has a croak that resembles that of the Edible Frog (*Rana esculenta*). If the thigh be pressed, the frog utters a cry, and gives out an odour of garlic, sometimes so strong and pungent as to affect the eyes. It lays long chains of eggs in March and April, which are held together by a glutinous matter. The tadpoles remain long in the water as such, their growth being slower than that of most frogs. It is found in France, near Paris, in ponds between Pontin and Bondy; in Alsace, and other places in the north of that country. In Belgium it has occurred at Antwerp, near Fort Carnot. It occurs, but not commonly, in Gallicia, the Bukovina, Silesia, and Carinola; and probably in the north of Italy.

Another species (*Bombinator igneus*) has the under surface sometimes smooth, sometimes with a few small glandular warts. The colour of the upper parts is a dull olive-brown, sometimes paler. There are small black spots on the edge of the upper jaw, and along the toes. All the lower parts are a fine orange or rose-colour, marbled, or spotted with blue or bluish-black.

It passes most of its time in the water; spawns in May and June; prefers ditches and ponds where the water is brackish. When frightened, and unable to escape, it raises its legs towards its head, throwing the latter back in a ridiculous manner, and squirting from the vent a frothy, acrid fluid.

It is found over nearly all the temperate regions of Europe, as well as in France, Germany, Switzerland, and Russia. In Italy, chiefly in the Apennines—never in the plains. It is very common in pools among the wooded hills and heaths of the Ardennes; also in Silesia. It is not rare in Gallicia, the Bukovina, and Carinola.

Liopelma hochstetteri is found in New Zealand ; while Nannophryne variegata is a little toad-like frog, found by Dr. Cunningham at Puerto Bueno, Straits of Magellan.

FAMILY XIII.—ALYTIDÆ.

In these frogs the ears are perfect, and they have neck glands. The tongue is fixed in front, and the toes are not dilated at the tips. In some of the genera (Alytes, Schaphiopus) the toes are more or less webbed; in others (Uperoleia) they are free. The peculiar habits of one of these frogs (Alytes obstetricans), which is not rare in Europe, are interesting. It is a small frog, about one inch and a half long, the upper parts sometimes inclining to grey, sometimes olive, feebly and irregularly spotted with brown, red-brown, or brick-coloured marks of small size. Beneath it is white, finely speckled with black on the throat, the sides of the abdomen, and under each of the legs.

The female produces in March from fifty to sixty eggs, about as large as a grain of millet, joined together in a sort of chain by the glutinous substance with which they are surrounded. While these eggs are leaving the body of the female, the male, who is always in attendance, places them around his thighs, to which they adhere, and where they remain until the young tadpoles are ready to come forth. This interval is spent by the male frog in a hole two or three feet under ground. As the moment for the bursting of the eggs approaches the animal takes to the water, which assists him to get rid of his burden. This curious species is further remarkable for its shrill croak or note, which has been compared to the sound of a glass bell.

It inhabits most of the temperate parts of Europe, preferring the central to the southern countries. It is very common in France, especially near Paris.

Schaphiopus solitarius and other species of this genus are found in America from California to Mexico. Hyperolius Seychellensis is from the Seychelles. Another species (*H. madagascariensis*) is found at Madagascar, and there are a great number of other species found in Africa and Australia. Heleioporus albo-punctatus is essentially an Australian species.

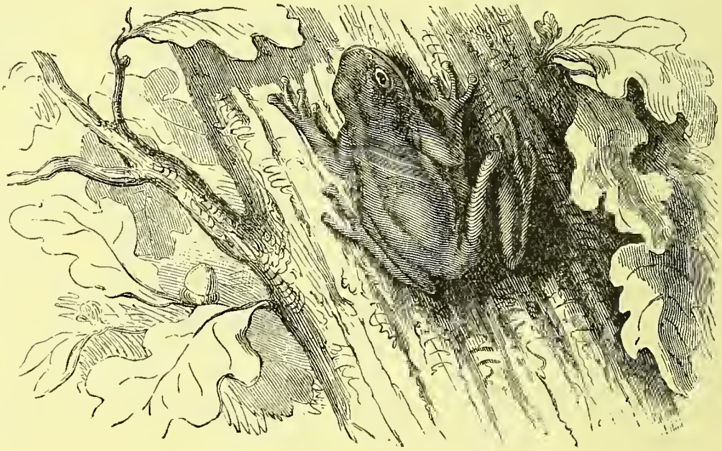
FAMILY XIV.—PELODRYADÆ.

This family contains a few species of tree-frogs, with the toes dilated at the tips, enabling them to climb trees, and with neck-glands; the toes are sometimes webbed, sometimes free. One of the best known species (*Pelodryas cœruleus*) is common about Port Essington; while Phyllomedusa bicolor is a pretty species, blue, with white spots, equally common in Brazil.

FAMILY XV.—HYLIDÆ.

These are the true tree-frogs. They have no neck-glands, and the end of the toes are dilated into disk-shaped bodies. They are arboreal in their habits.

The Green Tree-frog (*Hyla arborea*) is a native of Europe, but is not found in the British Islands. It is found in the Crimea, Caucasus, along the Euphrates Valley, and as far east as China and Japan. It also occurs in the north of Africa.



THE GREEN TREE-FROG (*Hyla arborea*).

Like the rest of its race, it commences its existence as an aquatic animal; and when adult it visits the water to deposit its eggs. It also hibernates in the mud, at the bottom of lakes and marshes. Towards the end of April the tree-frog quits its leafy abode, in order to deposit its eggs in the water of some neighbouring marsh. Numbers are now collected for the same purpose, the males being conspicuous by the distention of their throat, which assumes a tint of brown, and by their loud hoarse croakings, which rival in vehemence the well-known notes of the common frog. The first croak uttered is a signal for a union of discordant voices. So astounding is the clamour, that at a distance it might be taken for the cry of a pack of hounds in full chase; and during the tranquillity of a calm evening, or in the stillness of night, their combined voices may be frequently heard at great distances, especially on the approach of rain. After the breeding season the tree-frog becomes of a reddish-brown, which soon changes to grey, mottled with reddish; the colour next assumed is blue, and this again changes to green, which is the summer tint. After the young are hatched, as in the case of the common frog, by the heat of the sun, they remain in their tadpole state for about two months, swimming in their native element, and devouring small insects and worms. When the tail and gills have disappeared, and the lungs and limbs are developed, the little creatures, full of activity, and guided by unerring instinct, leave the water, and make their way to the adjacent woods, there to join their parents among the foliage. Swarms of these young frogs are occasionally seen, leaping among the bushes and trees which border the lakes and marshes of their favourite districts. The tree-frog does not attain its full growth till the fourth year; nor does it breed till this period arrives.

At the close of summer and the setting in of autumn, this little creature, warned by the failure of its insect food, and by the chilliness of the atmosphere, prepares for its winter repose. Unlike summer birds, which it imitates in its arboreal habits, it cannot migrate to a hotter or more southern clime; but like the common frog, and various other Batrachia, it hibernates; not suspended from barn-rafters, or in holes, as the bat, nor in little warm nests, like the dormouse, but in the deep mud of the marsh or lake. To the water, then, a second time, does it retire. In it plunges, and buries itself in the soft mud at the bottom; when it gradually sinks into a state of torpor, in which the functions of life are suspended. Thus the winter months are passed, till spring returns, and reanimates the face of nature; then it again makes its appearance, and seeks the fresh foliage of the trees.

It is about an inch and a half in length, and is of a light green above, sometimes spotted with black; beneath it is white, with a rosy tinge on the toes. There are more than sixty species of this genus, most of which are found in America, North and South. H. versicolor is the common North American form. Some occur in Australia, where, perhaps, H. aurea is the commonest species. Nototrema marsupiatum is a tree-frog from Mexico, with a pouch on the back of the adult females, into which the eggs, when laid, are packed by the male frog.

Trachycephalus lichenatus is thus described by Mr. Gosse:—"A very fine species, as to form, colour, and size, was brought to me in May, from the summit of Bluefields Mountain. It was of that curious genus named, by M.M. Duméril and Bibron, Trachycephalus, having a distinct neck, a triangular trunk terminating in a point, and an enormous flat head, studded with irregular, sharp, bony ridges. The three species designated by those learned herpetologists are assigned respectively to Brazil, Hayti, and Cuba; the present is manifestly distinct from either, marked by superior size, a peculiar style of coloration, greater development of the bony ridges of the head, and the prominent projection of the sacrum. It is a far finer, though more uncouth species, than any yet described. I therefore propose to call it, from its resemblance to the moss-grown bark of a tree, the Lichened Tree-toad (*Trachycephalus lichenatus*).

"During the short period that this fine reptile remained under my observation it was impatient of confinement, leaping vigorously. Now and then it inflated its body to a considerable degree, which was probably an expression of anger or an attempt to intimidate. A moisture exuded from its skin, which took the form of a very fine froth, even while on the body, and when touched appeared of a gummy nature, adhering to the fingers, and stiffening them as it dried. It left shining marks on the table too, like the trail of a snail.

"I was unfortunately called away, and had to remain from home for two days. I had placed the tree-toad under a bell-glass, knowing that it would not suffer from fasting, but forgetting that it would need moisture. When I returned it was just dead. Decomposition, however, had not commenced, so that I was enabled to add to my verbal description a carefully-coloured drawing, which I had commenced while it was yet alive."

FAMILY XVI.—POLYPEDATIDÆ.

The species of this family very much resemble the true tree-frogs, but instead of the processes that extend from the sacral vertebræ being broad and flattened out, here they are round. It is rather a large family, containing about 125 species. They are all to be met with in the tropical regions of the Old and New Worlds, and many of them are confined to a very small geographical area. For example, Megalicaulus infrarufus is only to be met with on the giant screw-pines that grow in the Seychelles. The species of the genus Polypedates are mostly found in British India. They are strictly arboreal, and most of them have the power of changing their colours. The common Indian Tree-frog (*P. maculatus*) is to be found in all suitable localities on the Continent of India and in Ceylon. It ascends the Sikkim Himalaya to a height of nearly 3,000 feet. The females are generally larger and more numerous than the males. Acris gryllus is a North American species, not uncommon about Philadelphia.

Another strange species is figured, and thus described by Mr. Wallace in his "Malay Archipelago":—"One of the most curious and interesting reptiles which I met with in Borneo was a large tree-frog, which was brought me by one of the Chinese workmen. He assured me that he had seen it come down in a slanting direction from a high tree, as if it flew. On examining it, I found the toes very long, and fully webbed to their very extremity, so that when expanded they offered a surface much larger than the body. The fore legs were also bordered by a membrane, and the body was capable of considerable inflation. The back and limbs were of a very deep, shining, green colour, the under surface and the inner toes yellow, while the webs were black, rayed with yellow. The body was about four inches long, while the webs of each hind foot, when fully expanded, covered a surface of four square inches, and the webs of all the feet together about twelve square inches. As the extremities of the toes had dilated discs for adhesion, showing the creature to be a true tree-frog, it is difficult to imagine that this immense membrane of the toes can be for the purpose of swimming only; and the account of the Chinaman that it flew down from the tree becomes more credible. This is, I believe, the first instance known of a 'flying-frog;' and it is very interesting to Darwinians, as showing that the variability of the toes, which have been already modified for purposes of swimming and adhesive climbing, have been taken advantage of to enable an allied species to pass through the air like the flying lizard. It would appear to be a new species of the genus Rhacophorus, which consists of several frogs of a much smaller size than this, and having the webs of the toes less developed."

One of the largest of the Asiatic Tree-frogs is another species of this genus (*R. maximus*). It is found in Nepaul and Sikkim, where it extends to an altitude of some 5,000 feet.

FAMILY XVII.—RANIDÆ.

The true frogs form a large, well-marked family of the batrachians, which numbers over 150 species; they have all webbed toes, and no neck glands. The processes of the sacral vertebræ are round, not flattened. The species are to be met with from the extreme north to the utmost south. They are equally at home in the tropics as in our native country, but some of the species have but a limited area of distribution. Probably the best known of all batrachians is our Common Frog (*Rana temporaria*); it is now to be found in every part of the British Islands, wherever there is water enough to enable the young to pass through their metamorphoses. It is asserted that the frog was not known in Ireland before 1700, when Dr. Gwythers, a physician, and a fellow of Trinity College, Dublin, brought over with him a parcel of frogs from England to Ireland, in order to propagate the species in that kingdom, and threw them into the ditches of the College park, but they all perished. Whereupon he sent to England for some bottles of the frog-spawn, which he threw into the same ditches, by which means the species of frog was propagated in that kingdom. However, their number was so small in 1720, that a frog was nowhere to be seen in Ireland except in the neighbourhood of the College park; but within six or seven years after, they spread thirty, forty, or fifty miles over the country, and so at last by degrees over the whole nation.

The ordinary voice of the frog is too well known to require particular description. In the spring every one has heard the neighbourhood of ponds and ditches, where these animals abound, resounding with their loud yet not disagreeable notes. When great numbers are congregated together, the noise heard at a distance is far from being unmusical, and when associated with the return of the genial season and the calm of a still, mild evening, is far more pleasant and soothing than many a more fashionable and dearly-bought noisy musical entertainment.

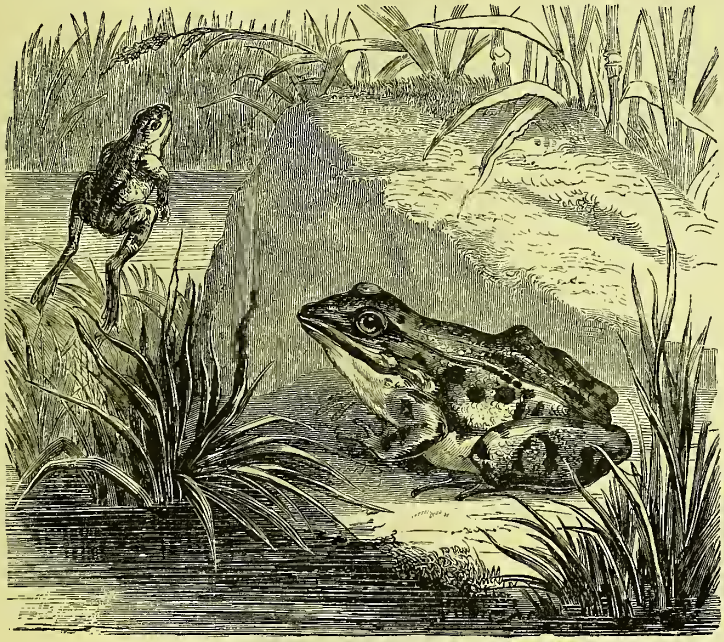
The food of the frog usually consists of various kinds of insects and of the smaller species of slug. So voracious are its habits during the whole of the season at which it feeds—for, like other cold-blooded terrestrial animals, it passes the cold part of the year in total abstinence—that it might become a most important assistant to the gardener or the farmer in the destruction of those pests of the respective objects of their culture which I have just named. It will swallow large coleopterous and other insects whole, and will take several of them at a meal. The quantity of insects and of slugs, indeed, which would be destroyed by encouraging these animals, instead of wantonly and unnecessarily persecuting and killing them, would be advantageous to a much greater extent than could at first sight be believed. This consideration ought surely to weigh, even with those who are inaccessible to the appeals of humanity, in favour of this innocent and much-persecuted species.

The manner in which the frog takes its food is very interesting. As in the toad, the tongue is doubled back upon itself when at rest; and being imbued with a viscous secretion at the extremity, it is suddenly thrown forwards upon the insect, which, being caught by the adhesive matter upon it, is instantly drawn into the mouth by the sudden return of the tongue to its former position, and is then swallowed. This is but the work of an instant; and, indeed, is performed with such rapidity, as scarcely to be detected without careful watching.

Like the rest of the Batrachia, the frogs retire, on the approach of winter, to their hibernating retreats, where they pass the dreary season in a state of absolute torpidity.

This is generally in the mud at the bottom of the water, where they are not only preserved in a nearly equal temperature, though at a low degree, but also secured from external injury. Here they congregate in multitudes, embracing each other so closely as to appear almost as one continuous mass. On the return of spring they separate from each other, emerge from their places of retirement, and re-commence their active life by exercising the important function of the reproduction of their species.

When first expelled, the frog-spawn consists of numerous small opaque globular eggs, enveloped in a small glairy or glutinous mass. This latter substance soon absorbs a large quantity of water, and in the course of an hour or two each mass becomes not less than a quarter of an inch in diameter. The consequence of this augmentation in the bulk of the transparent mass surrounding each egg is, that all the latter are removed from each other by a whole diameter of each globe; and they appear like black dots regularly distributed throughout a large mass of transparent jelly.



THE EDIBLE FROG (*Rana esculenta*).

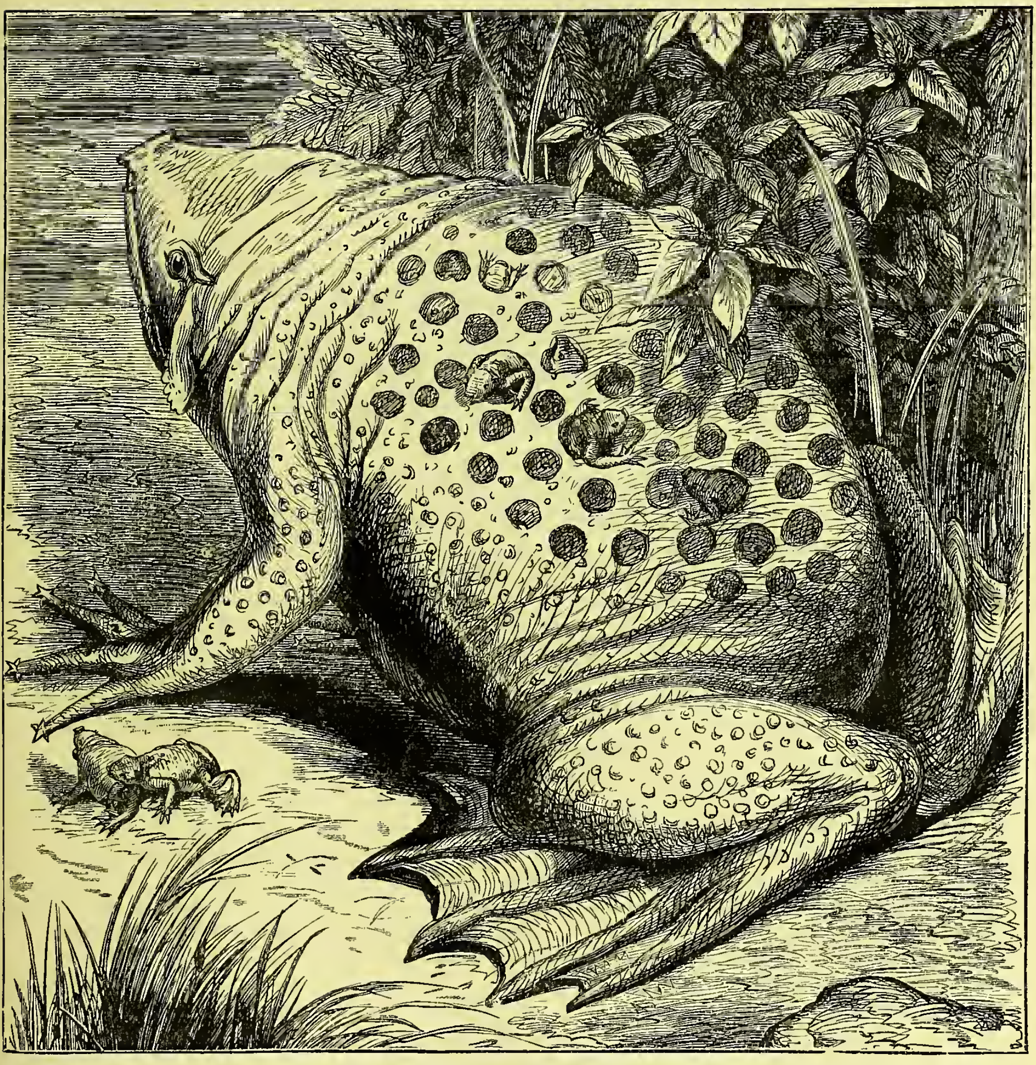
The deposit of the eggs takes place at the bottom of the water, notwithstanding the assertion of some naturalists—and of Rösel amongst them—that they are expelled at the surface. The mistake probably arose from the mass of eggs being generally found at the surface; but this arises merely from the after-floating of the glairy mass.

The Edible Frog (*R. esculenta*) is common on the continent of Europe, though not found in Britain. It spreads along by the north of Asia to Japan. It passes most of its time in the water, and its loud croak must be well known to all continental travellers. Its flesh is much esteemed as delicate and wholesome. As it deposits its spawn on water plants, the spawn masses are not so often to be seen floating on the surface of the water as in the case of the common frog.

The Bull Frog (*R. tigrina*) is very common over almost the whole of India. It is found in Ceylon, Southern India, Sikkim, Bengal, the Malayan Peninsula, and China, besides in different islands of the Archipelago. Specimens vary somewhat in size, in the more or less pointed form of the snout, in the length of the hind limbs, and in coloration. Bengal specimens do not attain to the same large size as those from Southern India, and generally have the white vertebral streak, or traces of it. Specimens from Ceylon are somewhat less stout in form, and their hind limbs are a little longer. But all these differences can hardly be considered as of specific importance. Although these bull-frogs attain to a very large size—the body alone measuring from six to seven inches in length—the young (after having passed the tadpole state) are comparatively very small, often only one inch long. These frogs are extremely numerous, and when frightened can jump over the surface of the water much in the same way as they do on land.

A resident at Fort Erie says, referring to the American Bull Frog (*R. mugiens*), "During the summer, I used frequently to angle in different parts of the lake for trout, and also would place floating lines across some of the convenient bays and inlets. My usual bait was a small live fish, to procure which I had to angle with a small hook, baited with a small worm, in the shallower water near the shore. One day, while I was thus employed, I observed a large bull-frog perched upon a prostrate tree, which lay partly immersed in the water. Having caught a sun-fish just at the moment I first observed the bull-frog—and that sort of fish being the least desirable kind of bait for trout-fishing—without unhooking it, I swung it as near the frog as practicable. I saw that he anxiously watched the movements of the fish, and, after some further attempts, I succeeded in placing it within a few inches of him, when he darted quickly upon it, and had it in his capacious mouth in an instant. I then drew him gently towards the small skiff in which I was sitting; but as he approached it he struggled so violently, that he either let go his hold or accidentally lost it, for he disappeared in the water for a few seconds, when I observed his green head close alongside of his favourite resting-place, and shortly afterwards he ventured quite out of the water, and took up his original abode. After this, our first interview, I found him daily occupying the same place; and in order to improve our acquaintance, I treated him regularly to a sun-fish breakfast. When our daily intercourse had continued for some weeks, I determined upon taking him prisoner. For this purpose I baited a large hook with a sun-fish, which I threw towards him; and the poor frog, unconscious of any harm, seized it with his usual avidity, when I struck the line somewhat smartly, and found that I had hooked him. I then drew him gently towards me, and, after some fruitless resistance on his part, hauled him into my skiff. He seemed dreadfully alarmed on my laying hold of him in order to relieve him from the hook and fish, which he had nearly swallowed; and having performed the operation without paining him more than necessary, and having detained him for half an hour, I then permitted him to plunge into his native element.

"I supposed that our acquaintance would probably end here; but no such thing: for on the following morning, when I repaired to my fishing-ground, I found him at his wonted station. I fed him daily as before, and could perceive that he allowed me to approach him much closer, without exhibiting the degree of alarm he had done at first. I one day *tied* a fish to the line without any hook, and after he had laid hold of it, pulled him quietly into the boat, when he struggled violently, ejected the fish from his stomach, leaped overboard, and swam to his place of refuge. Our intercourse after this became daily more familiar; so that, in the lapse of a few weeks, he would mount upon the flat part of an oar, when I held it close to him, and alight from it in the opposite end of the skiff from where I sat. Thither I would throw him a small sun-fish or two, which he quickly disposed of; after which, he would jump overboard or again mount the flat part of the oar, in order to be handed back to his resting-place. Soon after this he would take his accustomed allowance from my hand; at last permitted me to handle him gently, still, however, exhibiting some degree of timidity. After this, I took him across the lake, and confined him in a hogshead, open at both ends, which I placed near the shore, where the water was only about a foot deep. In the centre of the hogshead I placed a stone for him to perch upon, which arose just above the surface of the water. He remained a few days in this confinement, eating from my hand, until one day I found him missing, and concluded he had been devoured by a minx or an otter. But on examining the shore for a short distance, I discovered him perched on a decaying log, close to the water's edge. On calling him by the name (Ralph) to which I had lately accustomed him, I thought that he recognised my voice immediately. I took him in my hand without his attempting to escape, and returned him to his solitary abode. The next morning he again was missing, when I went in search, and found him near the same place as before. I now determined to watch his mode of escaping, for which purpose I hid myself in the bushes close by. I had remained there but a few minutes when I saw him spring clean over the upper edge of the hogshead into the water. The fact was this, that, from his great muscular strength and agility, he was able, at a single effort, to leap fairly over the top of the cask, which was three feet perpendicular above the top of his supporting stone. On discovering this, I removed the stone, and in its place gave him a floating piece of wood to perch upon, which I found to answer my purpose completely; for upon his making a spring, the perch gave way under the effort; he thereby lost his balance, and all his attempts were unavailing. Having satisfied myself of the practicability of making a domestic pet of a wild bull-frog, I made a present of Ralph to the daughter of a friend of mine, who promised to be kind to him and to have all his wants cared for. But I afterwards understood that the lake had been visited by a tremendous storm, which had overturned Ralph's prison-house, when, of course, he escaped; but whither, or what became of him, no one could ever tell."



THE SURINAM TOAD (*Pipa americana*).

Other species of this genus are to be found in almost every part of the globe, except in Australia and in the islands of the Pacific. Some of the species attain a very large size, feeding on other smaller frogs, young birds, &c. All the species are endowed with voice, which in the larger kinds is so loud that they have obtained the denomination of bull-frogs. The hind limbs are well developed, and all have the toes webbed; the web is extremely broad in some species, reaching to the tips of the toes, and these frogs are enabled to jump along the surface of the water as over the firm ground. All are eatable, and many species are brought to market in great quantities.

Australia, however, has a considerable number of genera and species quite peculiar to the region, such as Limnodynastes dorsalis.

In one remarkable species (*Pyxicephalus breviceps*), the metatarsus is provided with a flat, sharp-edged, shovel-like prominence, with the aid of which it can burrow into the ground to the extent of eighteen inches.

FAMILY XVIII.—DISCOGLOSSIDÆ.

This little family contains some frog-like batrachians, with neck-glands and broadly-dilated sacral vertebræ. The species are not more than twenty, and they have been placed in some fifteen genera. These frogs are for the most part natives of warm countries, but one species is found (*Discoglossus pictus*) in Greece, Sicily, and the north of Africa, and probably will be found all along the shores of the Mediterranean.

Another species (*Pelodytes punctatus*) has, we believe, not been met with outside France, where in Picardy and about Montpelier it frequents vineyards. In length of the body it is about one inch and a half. The ground colour of the upper parts is tawny mixed with ash, agreeably spotted with light green; below, white or flesh-colour, often with orange specks on the sides. Certain roughened places in the males are, during life, of a bright violet tint, but become almost black when the animal is dead, the green of the upper parts also turning in like manner. It frequents pools and other pieces of water in the spring and summer. In the autumn it is found in shrubby places.

FAMILY XIX.—PIPIDÆ.

The only species belonging to this family is the Surinam Toad (*Pipa americana*). It has long been known as affording an example of a most remarkable and anomalous mode of reproduction. At the breeding season the female exhibits on her back a number of singular pits, each of which receives an egg, and the young animal—which, as usual, makes its first appearance in the form of a tadpole—undergoes its changes in this confined space, and emerges at once a perfect toad. These facts have been known for many years, and for a long time it was supposed that the eggs (which are completely enclosed in the dorsal cells) were produced immediately in the place where they were found, without going through the process usual amongst the other Anura. It has been found, however, that the Pipa does not differ from its fellows in this respect; but the mode in which the ova reach their destination certainly affords a curious example of instinct. The female deposits her eggs at the margin of the water, but the male, instead of merely impregnating them, and leaving them to their fate, takes the trouble to collect the whole mass of eggs and deposit them upon the back of his partner, where they are pressed into the open cells, which are afterwards closed with a sort of lid. The development of the embryo then takes place in these cells, in exactly the same way as with the free larvæ of the other Batrachia. The Surinam toad is commonly found in the dark corners of houses in Guiana and Surinam. It is, perhaps, one of the ugliest of the toads; but notwithstanding its disgusting appearance, it is eaten by the natives.

CLASS V.—FISHES.

We now arrive at the consideration of the lowest class of the vertebrates—that of the fishes. No class is better known. It is also a very large class, there being probably in it nearly 10,000 species. Some fishes attain considerable proportions, as among the sharks examples have been measured over forty feet in length, but others are not more than a single inch in length. The structures to be met with in the class also vary much, some of them being very highly organised, and others being among the very lowest in organisation of all vertebrated beings. In their habits they are essentially aquatic. There is scarcely a fresh-water river, and no part of the sea, that is not inhabited by them. Some of them have an immense geographical distribution, while others would seem restricted to some little lake; some live on the surface of the sea, or nearly so, others at stupendous depths below that surface; some are equally at home in salt and fresh water.

All fishes breathe by means of gills (branchiæ), and these are placed as fringes along a series of arches, the clefts between which open out of the wall of that part of the body which lies just at the sides of, and immediately behind the mouth, so that by this means the cavity of the pharynx is put in communication with the exterior. Fins, which are for the most part formed by prolongations of the integument, are always to be met with in fish, though these fins differ immensely as to their amount of development. When the anterior and posterior limbs are present they have the appearance of fins. Many other peculiarities will be seen as we proceed with our notice of the different systems to be met with in this class.

The Tegumentary System.—This is well and characteristically developed in the class. The skin of fishes is generally more tightly stretched over the body than in the other vertebrates, and so it enjoys less mobility. Sometimes it gives origin to little prominences, which are often very small, but in others assume large dimensions, and act the part of tactile papillæ or organs of touch. In some the outer layer of the skin is soft, as in the eel, and on removing it minute narrow oblong scales will be seen buried in the inner layer. These delicate scales consist of a finely reticulate cartilage. In other fishes, as in the sand-eel, these begin to augment in size, and one edge rises up and pushes the outer skin layer before it; but in most fishes these scales are to a very large extent pushed through the outer skin, and form a dense tile-like covering over the fish's body. Sometimes these scales will consist of a dentine-like structure; in others, the bony matter will surround and cover over, and as it were replace the dentine layer, and the scale will then form a large dense structure, so well seen in some of the sturgeons. It will hence be evident that the outgrowth of teeth and fish-scales have very much in common.

According as the outer edge of the scale is flat and smooth, or adorned with comb-like serrations, so is it called cycloid (circle-like), or ctenoid (comb-like). The outer layer of the skin is generally of a slimy consistence, which will account for the extreme slipperiness of some fish; but in those in which the scale system is well developed this sliminess will not be so much marked.

The Osseous System makes its first appearance in this class. It will be remembered that all the animals belonging to the so-called vertebrate section of the animal kingdom possess, running along as a central axis to their bodies, a cartilaginous rod, out of which is ossified the chain of bones called vertebral column. When this central axis is in a condition of soft cartilage it receives the name notochord; but in the mammals, birds, reptiles, and amphibia, this condition was only a transitory one, for by the process of bony growth, by which the joints of the back-bone are formed, it quite disappeared. In the fishes, however, we mostly find the notochord remaining as a permanent axis. In some this cartilaginous rod is not even divided into segments, but as we ascend in the scale parts of it become segmented and ossified, until in the bony fishes each joint is ossified in a more or less well-marked degree. When a skeleton is present it may thus be either all bony or partly bony, and partly cartilaginous or wholly cartilaginous. The number of the vertebræ varies much; as many as one for each day in the year have been counted in some sharks, while the number is as low as sixteen in some species. The fish's body may be divided into the head, the body, and the tail. The limbs are changed into organs called fins. The anterior pair receive the name of the pectoral (chest) fins—they are placed just behind the gill-openings; the posterior pair are called ventral fins, from their normal position being on the belly. These latter are, however, not so intimately fixed to the trunk as the former, and we find them varying their position, sometimes advancing forwards near to the pectorals, and sometimes even getting in front of them, quite under the fish's throat.

Other fins there are, but these are not in pairs. The back of the fish may have a fin, and then this will be called the dorsal fin. It may form an entire fin, as in the turbot, or be broken up into several, as in the mackerel.

The extremity of the tail generally carries a fin, which is called the caudal fin, and close to it on the under surface of the body is the last of the unpaired fins, called the anal. About the caudal fin there is a good deal of interest. Most people know the difference in shape that there is between the tail (caudal fin) of a salmon and that of a shark; how in the former the lobes of the fin seem to be equal or symmetrical (homocercal), and in the latter, only the lower lobe of the fin is, as it were, developed, and the back-bones (vertebræ) of the fish seem to be prolonged into the feebly-developed upper lobe (heterocercal). This remarkable distinction was first of all recognised by Agassiz, and long ago Owen wrote that "the preponderance of heterocercal fishes in the seas of the geological epochs of our planet is very remarkable. The prolongation of the superior lobe characterises every fossil fish of the strata anterior to and including the magnesian limestone. The homocercal fishes first appear above that formation, and gradually predominate until, as in the present period, the heterocercal bony fishes are almost limited to a single ganoid genus (Lepidosteus)." "Indeed," writes Professor Owen in another place, "it [the heterocercal] was the fashion of tail which prevailed among fishes throughout the Palæozoic and Triassic periods."

It never seems to have been settled whether the fish with the homocercal tail was or was not better off than the fish with the heterocercal tail. If the more recent fishes have improved in this matter of tails upon their predecessors, as was to have been expected, certain it is that the shark of to-day can wheel quickly enough about in pursuit of his prey, and that the sword-fish can come thundering against a ship's timber with a vigour not easily matched by any fish with a symmetrical tail. Be this, however, as it may, the structure of fishes' tails has engaged the attention of most of our comparative anatomists, and the student will find large stores of facts collected and arranged for him by Agassiz, Vogt, Owen, Kölliker, Hæckel, Huxley, and Lotz. The latter four anatomists have plainly shown that while the external appearance of the tail of modern bony fishes is, as we have seen, homocercal, their real structure is only a modified heterocercal one, so that, as far as we now know, the tail of all fishes is built upon modifications of the same type, and Alexander Agassiz proves still further that this tail-fin does not differ in its mode of development from the primitive embryonic fin, or from that of the back (dorsal) fin. He describes the gradual change of the embryonic tail in several species of bony fishes, and he calls attention to the remarkable presence of an embryonic caudal lobe, which has, to this, apparently escaped the attention of naturalists, and which shows remarkably well the identity of growth between the tails of ganoid and of bony fish.

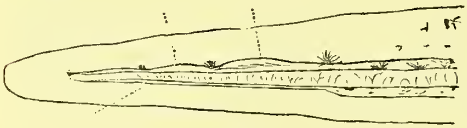


FIG. 1.

Alexander Agassiz traces the changes gradually taking place in the tail of the common flounder, from the time the little fish leaves the egg until it has nearly assumed the final shape of the adult. At first (Fig. 1) the caudal end of the chorda is straight; the caudal fin is rounded. In the next, the caudal extremity of the chorda has become slightly bent upwards, and there will be found the first trace of the division line between the embryonic and the permanent caudal fins. In further stages this indentation between these two becomes more marked, the chord becomes more arched, and the permanent caudal at length projects beyond the outline of the embryonic fin fold, so that antecedent to the ossification of any of the vertebral column, the tail has assumed a heterocercal form. In the stage (Fig. 2) in which the embryonic caudal assumes the shape of a large independent lobe, while the permanent fin appears like a second anal fin, the resemblance to the tail of a young Lepidosteus is most striking. The extremity of the notochord at last disappears preparatory to the formation of the urostyle, while the permanent caudal gradually develops, and soon it (Fig. 3) presents the general outline of the adult form.

Alexander Agassiz has traced the presence of this remarkable embryonic caudal lobe in a large number of genera of bony fish. In the young of Syngnathus it is well marked.

In the young of the fishing-frog (Lophius) the termination of the notochord remains unchanged quite late in life, but in all the genera examined the permanent tail passes quite gradually from a strictly ventral appendage placed below the dorsal column, to that of a terminal tail placed in the continuation of the vertebral column. He thinks that though Agassiz and Vogt were mistaken as to their details, their great generalisation will still remain true, and that there is a complete accordance between the embryonic growth of their tails and the development of fishes in time, only we must now remember that the heterocercal tail is *not* the earliest stage—that the earliest stage is a nearly symmetrical one; this, which he calls the leptocardial stage, is that assumed by the tails of bony as well as of all other fishes, and precedes the heterocercal stage. As to the palæontological record, if one examines the tails of the Devonian fish, as we know them from the restorations of Agassiz, Hugh Miller, Hæckel, Huxley, and others, one is quite struck by the perfect parallelism of these ancient fishes, as far as the structure of their tail is concerned, with the structure of the stages of the flounder's tail already referred to, thus carrying out the parallelism of Agassiz and Vogt far beyond anything they even conjectured.

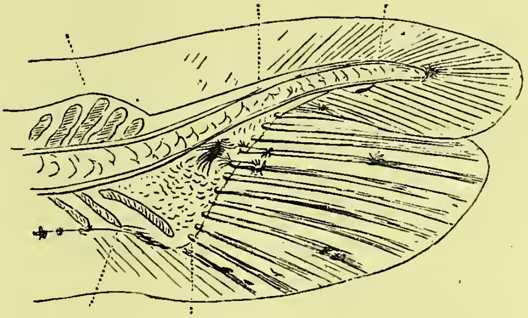


FIG. 2.

Of the paired fins one or both pairs are very often absent. They consist in all essentials of the same parts more feebly represented, as will be found in other vertebrated animals; but the unpaired fins are to be regarded as merely developments of the skin system, and are supported by rod-like rays, which are sometimes quite hard and bony.

The skull of fishes may be bony or cartilaginous; except in one fish (amphioxus) it is always present. In either case, it is very variable in the number and arrangement of its component parts. In the bony fishes the skull is of a very complicated structure indeed, and it is noteworthy that there is scarcely a bone that enters into the boxing in of the mouth cavity that may not be furnished with teeth; indeed, even the rays on which the gills are stretched are almost always furnished with teeth. In fish these teeth are almost never inserted into sockets, but are merely attached to the surface of the bone which supports them. In most fishes they can be, and are constantly being, changed. As the old ones drop away new ones come on. In external form they vary much. We find teeth in the form of pavements of perfect cubes, and of prisms, with three sides (Myletes), four sides (Scarus), five or six (Myliobates). They may be minute, sharp-pointed, and slender, like the pile of velvet; they may be, as in some sharks, like the canine teeth of some carnivorous mammal. In some fishes (Lophius) they are movable, in others they become ossified to the jaws. Sometimes they are only used to seize the prey; other times, as in the Scari, they are immensely strong, and can pick even the growing tips of the coral masses to pieces. They lead us to the next system.

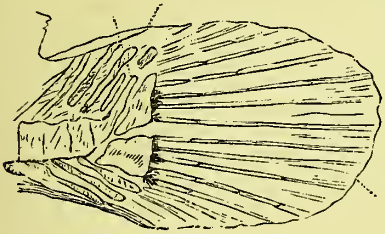


FIG. 3.

THE ALIMENTARY SYSTEM.—Nothing can be imagined simpler than this system, as it is found in the lowest of fishes, the amphioxus. The alimentary canal extends in almost a straight line from the gullet on; but while in most generally short, simple, but capacious, it is often to be found disposed in folds. In some the special cavity called stomach is not well defined; the gullet is usually short, with, in some fishes, a muscular arrangement to prevent the return of prey swallowed alive. The stomach itself is generally capacious, and while the opening into it from the gullet is large, the opening out of it into the intestine is often very small. In some fishes the stomach will be bent on itself (shark, turbot, salmon), in others it is sack-like (perch, pilchard), very rarely is it globular (Mormyrus). The end of the stomach nearest the intestine is often provided with a number of appendages (cœcal). In the whiting these pyloric appendages are over one hundred in number; there are even more in the eel; there is not even a single one in the sand-lance; there are two in the turbot, three in the perch, and so on. They are supposed to represent the pancreas.

The rest of the intestine is more or less rolled up or convoluted. In some few fishes (Selache) there is just below the commencement of the small intestine a spiral valve. The anal orifice, though usually placed at the posterior portion of the body, is in many cases brought forward, and sometimes is to be seen close under the throat. The liver in amphioxus is a very rudimentary organ, but in the higher fishes it becomes a well-defined organ, with its own circulation and generally a gall-bladder. Its texture is soft, its colour sometimes whitish; but it varies through many shades of red, brown, orange, green, and black. In most fishes it is remarkable for the quantity of fine oil in its substance; and in some, such as the cod, shark, and ray, all the fatty substance of their bodies seems to be concentrated in their livers, while in other fish, as the salmon, the oil is found diffused throughout their bodies, and but little of it will be found in their liver. It varies much in shape. A spleen is also present.

THE BLOOD SYSTEM.—With but the exception of the amphioxus, all fishes possess a muscular heart; this is to be found under the throat. It is formed of but two cavities—one the receiving-chamber (auricle), the other the propelling-chamber (ventricle). When full the auricle is larger in proportion to the ventricle than in other vertebrates. Its walls are membranous, its cavity is simple, and only in the mud-fish is there a trace of a division. It has also in this fish two ear-like appendages. The ventricle is sometimes pyriform (Lepidosteus), oval (Lophius), but more generally is it pyramidal. Its cavity is simple, its walls are very muscular, and the fibres are redder than those of any other part of the muscular system.

The main artery leaving the ventricle is generally swollen at its base (bulbus arteriosus), and the muscular walls of this portion are distinct in all fishes from those of the ventricle. The blood sent from the ventricle through this artery enters into the branchial vessels, which carry it to the gills (branchiæ), where it comes into contact with the air in the water, becomes oxygenated, is then again collected from the minute blood-vessels that in this state take it up, into larger vessels, and is then conveyed through the principal artery (aorta) to the various organs which it supplies with nourishment, and the used-up blood is collected by the veins, and having taken a course through the liver, where it meets with fresh material, it so eventually makes its way back to the heart.

The gills (branchiæ) are organs highly characteristic of fishes. They are situated on either side of the body, slightly beneath and behind the head, and are protected by opercula, or gill-covers. Sometimes the gill-openings are formed by a series of apertures, which each lead into a gill-cavity. Sometimes these apertures assume the form of elongated slits, which in the shark will be found on the sides of the neck, and sometimes there is but one gill-opening. In most fish the water passes through the mouth to the pharynx, and is then sent right and left to the gill-cavities, where, in passing over the very delicate fringes of the gills, the venous blood distributed therein lays hold on the oxygen of the air that is entangled in the water, and so the process of respiration is effected, and the used-up stream of water flows away through the gill-openings. But in some fishes, as the shark, the branchial or gill-sacs are completely separated one from another, and so the water, by a special arrangement, passes into and out of each cavity separately; and in a few fishes like the lamprey, where, because the mouth is suctorial, and while it is attached to some foreign body, no water can pass to the gill-cavities through it, the currents are seen to pass into one set of the external orifices, and after traversing the corresponding sacs and pharynx, to pass through the opposite gills, and to be ejected therefrom through the opposite row of openings. In some sharks a wonderful fringe-like arrangement clothes the edges of the gill-arches, and these in the basking shark assume the form of a number of whalebone-like plates.

Here it will be convenient to mention that in some fishes accessory breathing organs are to be met with, by means of which the fish can breathe for a while out of the water. Thus, in the climbing perch there is a reservoir of water developed from the upper part of its gullet; and in another fish (Heterobranchus) this organ resembles a little tree of red coral—it is red and muscular; also in the cuchia, a snake-like fish to be found in the marshes of Bengal, there is a very complicated accessory organ. The Gangetic singio

(Saccobranchus) is, by a wonderful modification of its opercular gill, enabled to ærate its blood while travelling on land to a great distance from its native rivers or marshes.

Nor must all mention of the so-called air-bladder in fishes be omitted. It is found in many fishes in the form of an elongated bladder, densely filled with air, which extends along the back, beneath the back-bone, sometimes to near the end of the tail. It is sometimes bifurcate. It is even (but rarely) almost divided lengthwise into two bladders (Polypterus, Lepidosiren), but more often is it divided crosswise into two chambers, which may communicate by a narrow orifice (Cyprinus), or may not (Bagrus); but indeed its shape varies immensely. In the common cod (Gadus) it is known as the sound, and has a number of blind processes continued from both its sides and ends. It is generally lined by a delicate mucous membrane, but in some it becomes quite lung-like (Lepidosiren). It is altogether wanting in the sharks, in the flat fish (Pleuronectidæ), as well as in many isolated species. It is sometimes present in one species of a genus and sometimes absent. It is supposed to be homologous with the lungs of the higher vertebrates, although not performing the functions thereof.

Fishes are all essentially oviparous. The ovaries are popularly known under the name of the roe, and when fully distended with eggs (ova) often assume very large dimensions. After the eggs are deposited by the female fish they are fertilised by the milt of the male fish. Some few fishes are ovo-viviparous—that is to say, the eggs are retained in the egg-passages (oviducts) until the young fish are formed. As a rule, fishes seem to have no care for their offspring, and yet there are some very interesting exceptions. Our common little stickleback builds quite a pretty nest for its eggs, and in some instances the male fish mounts guard to protect its young.

On the gentle angler's art the great Sir Humphry Davy thus writes:—"The search after food is an instinct belonging to our nature; and from the savage, in his rudest and most primitive state, who destroys a piece of game or a fish with a club or spear, to man in the most cultivated state of society, who employs artifice, machinery, and the resources of various other animals to secure his object, the origin of the pleasure is similar, and its object the same; but that kind of it requiring most art may be said to characterise man in his highest or intellectual state; and the fisher for salmon and trout with the fly employs not only machinery to assist his physical powers, but applies sagacity to conquer difficulties; and the pleasure derived from ingenious resources and devices, as well as from active pursuit, belongs to this amusement. Then as to its philosophical tendency, it is a pursuit of moral discipline, requiring patience, forbearance, and command of temper. As connected with natural science, it may be vaunted as demanding a knowledge of the habits of a considerable tribe of created beings—fishes, and the animals that they prey upon—and an acquaintance with the signs and tokens of the weather and its changes, the nature of waters, and of the atmosphere. As to its poetical relations, it carries us into the most wild and beautiful scenery of Nature; amongst the mountain lakes, and the clear and lovely streams that gush from the higher ranges of elevated hills, or that make their way through the cavities of calcareous strata. How delightful in the early spring, after the dull and tedious time of winter, when the frosts disappear and the sunshine warms the earth and waters, to wander forth by some clear stream, to see the leaf bursting from the purple bud, to scent the odours of the bank perfumed by the violet, and enamelled, as it were, with the primrose and the daisy; to wander upon the fresh turf below the shade of trees, whose bright blossoms are filled with the music of the bee; and on the surface of the waters to view the gaudy flies sparkling like animated gems in the sunbeams, whilst the bright and beautiful trout is watching them from below; to hear the twittering of the water-birds, who, alarmed at your approach, rapidly hide themselves beneath the flowers and leaves of the water-lily; and as the season advances, to find all these objects changed for others of the same kind, but better and brighter, till the swallow and the trout contend, as it were, for the gaudy May-fly, and till, in pursuing your amusement in the calm and balmy evening, you are serenaded by the songs of the cheerful thrush and melodious nightingale, performing the offices of paternal love, in thickets ornamented with the rose and woodbine!"

And as a pendent we take the following from Mr. Gosse's charming work on Jamaica, on tropical fishes and fishing:—

"But all of these yield in beauty to the different species of Hœmulon, which, under the name of grunts, are well known and highly esteemed throughout the Caribbean Sea. The names scientifically bestowed on many West Indian species, such as elegans, formosum, xanthopteron, &c., indicate their pretensions to beauty. Their characteristic markings and hues are oblique parallel lines of gold, on a silver or metallic azure ground, with delicately-tinted fins, and sometimes spots of peculiarly intense lustre; the whole interior of their mouths is generally of the finest scarlet.

"All of these are taken with the line and with the seine, as well as in pots. The snappers are perhaps more highly esteemed than the grunts, but both are excellent. They chiefly affect what is called "broken ground," where patches of white sand alternate with masses of rough rock and fields of grass-like weeds. They range from deep water to the rocky shore, are taken abundantly with the seine, and bite freely at a bait of sprat (*Harengula clupeola*); but only fish of small and middling size are commonly caught in pots. The snappers occasionally attain a length of two feet and a half; but fish of such dimensions will rarely bite at a hook worked in the usual manner. For them the negro fisherman takes a wire hook (No. 1 or 2) as large as a goose-quill, which he throws overboard, baited with a sprat, but in a peculiar fashion. One side of the sprat is split nearly off, remaining attached only by the tail. This is allowed to hang free, and a slice from the back and one from the belly are allowed to hang in the same way. The hook is then passed in at the mouth, out at the gills, and again through the middle, and the head is tied to the top of the hook; another slice is then put upon the hook, and made to hang down. This is designated a "full bait." No sinker is attached, but its own weight is sufficient to carry it nearly to the bottom. The line being passed with two turns round the fisherman's great toe, he lies comfortably down in his canoe (Blackie will always lie down whenever he can), and awaits the bite of the first large fish that may choose to essay the baited hook, which it usually does by taking in the whole at a gulp.

"The seine is here, as elsewhere, the chief resource of the fisherman; and many kinds of fishes are taken by this means that rarely enter a pot or seize a bait, together with many species that he calls rubbish, as being of no esteem in the market, though often interesting to the naturalist. There are several places in the vicinity of Bluefields where the peculiarities of the beach and of the shoaling water are favourable to the hauling of the seine. One of these is Belmont Beach, already spoken of; another, still more used, is the beach at Cave, a few miles to leeward, where a lofty spur from Bluefields ridge juts out in a bold promontory to the very edge of the sea. The wooded mountain side descends abruptly, almost precipitously, leaving only a narrow beach of white coral sand curving round its foot, along which the high road winds from the windward parts to Savanna-le-Mar and onward.

"I have often admired the loveliness of the scene presented by the termination of this promontory, frowning down upon the beautiful bay beneath, especially in the early morning, while the sun, if risen above the actual horizon, has yet far to climb before a single ray can shoot over the shaggy summit of the ridge; and the whole mountain-side, covered with a dense forest in every part, except when a little white cottage is perched at mid-height, casts a deep black shadow, reflected as in a mirror from the calm water below. Beyond the promontory the low mangrove-shore trends away to the westward, and from the level country behind rises in majestic elevation the steep mountain mass known as the Dolphin's Head, clear and distinct, but empurpled by distance.

"The foreground of the landscape, of which I have made a sketch, is the summit of a shelving cliff at Lindo, overgrown with bushes and herbaceous vegetation in rude luxuriant wildness. From the midst of this tangled bed of weeds and shrubs the singular forms of the papau (*Carica papaya*) and the trumpet-tree (*Cecropia peltata*) erect themselves; and a huge silk cotton-tree (*Eriodendron anfractuosum*), hoary with age, towers and spreads overhead, with many slender leaves depending like long strings from its branches.

"In the bottom of the bight, upon the narrow beach, that looks like a thread of silver between the black mountain and the equally black reflection, we see several moving atoms, and a little speck slowly glides out into the still, calm bay. These are the fishermen, and this is their canoe, in which they are carrying out their ground seine. One end of a long rope is made fast on shore and the seine is attached to the other extremity. When the canoe has got as far as the rope will allow, the seine, loaded and corked, is gradually dropped parallel to the shore, and a rope of similar length to the former, but attached to the other side of the net, is brought to land.

"If we leave our post of observation, and walk leisurely down towards the beach, we shall arrive by the time they begin to haul. It is a pleasant road, and at this hour, beneath the cool shadow of the mountain, walking is a very different thing from what it would be in the after part of the day,

——'sol ubi montium
Mutaret umbras,'

when the fierce beams will glare upon us with twofold rigour—one sun in the sky and another in the sea. Tall trees overhang the road on both sides for part of the way, many of them covered with beautiful blossom; fine flowering shrubs display their charms amidst the bush, and some magnificent butterflies hover about, and flap their heavy wings over the summits of the trees, now and then alighting on the lofty leaves. Here and there tall cliffs of rugged rock rise perpendicularly from the road-side, their roughness half concealed by the multitude of shrubs and slender trees that jut out from the crevices, and by the climbing and trailing plants that throw wild, graceful festoons over their sides. Among them grows in profusion the Portlandia grandiflora, having much the aspect of a climber, from its height and slenderness, and from its growing close to the face of the rock, conspicuous, above all, for its magnificent trumpet-shaped flowers, of purest white, eight inches in length, and its large glossy oval leaves of deepest green.

"We cross a streamlet, which, from some machinery formerly erected here, passes by the name of Water-wheel, and where a rude aqueduct, carried out a few hundred yards into the sea, enables ships' boats to fill their water-casks without the danger of beaching. Here a deep morass borders the road, inhabited by myriads of land-crabs (*Gecarcinus ruricola*), whose burrows riddle the ground so completely that, even by the road-side, it is dangerous for a horse to pass. The morass is covered with trees, among which the cork-wood or alligator-apple (*Anona palustris*) is abundant, displaying its beautiful and fragrant but noxious fruit, which, nevertheless, affords food to these crabs, to morass-galliwasps (*Celestus occiduus*), and, as is believed, to the formidable crocodile.

"The sound of human voices in melody falls now upon the ear—the song of the negroes, who have begun to haul the seine. Rude their music is, and artless their tune; yet, mellowed and softened by distance, now swelling in chorus, now feeble and faint, it has considerable sweetness, as the human voice always has under such circumstances. Yonder we see them, forming two lines in the water, ten or a dozen men in each row, hauling upon the two ropes, the utmost up to the neck in the sea, and the inmost on the beach; all naked, regardless of the burning sun that now pours down his beams upon their woolly heads and glossy backs. It is a slow operation; and as they all throw their weight on the line together, they sway backward and forward in time with the wild air whose notes they are singing.

"In an hour or two, the fishes that the seine has enclosed are dragged on shore, and lie gasping and fluttering on the wet sand. Let us see what they have taken. Here is the usual predominance of grunts and snappers, hamlets and hinds; two pretty Chœtodons: C. capistratus, with its eye-like spot on the tail, and C. striatus, with its black bands; two kinds of doctor-fish, so called from the curious glassy lancets that they carry in a sheath on each side of the tail: Acanthurus chirurgus, and A. cœruleus; and a parrot-fish (*Scarus cœruleus*), remarkable for its abrupt, almost vertical, profile, white eye, and brilliant azure hue. I observe that the two divisions of the upper jaw in this fish are capable during life of separate motion, up and down, a circumstance, I think, not before noticed. Here is a Muræna, looking as if it had been varnished; another lengthened fish, of curious form and remarkable style of colouring—rust-red, with longitudinal white lines and numerous black dots; a species of Aulostoma, to which the negroes give the name of soap-fish. Here, too, is what they call a flounder, but truly a kind of turbot (*Rhombus argus*), a handsomely-marked fish, being studded all over the upper side with large blue rings, enclosing pale yellow areas on a dusky brown ground colour. There are many other things—young sharks, hedgehog-fishes, trunk-fishes, *et hoc genus omne;* but these we must leave, and make the best of our way back to Bluefields, or we shall not be in time for 'second breakfast.'"

The following remarkable facts are mentioned by Sir J. E. Tennant:—

"So abundant are fish in all parts of Ceylon that, Knox says, not the running streams alone, but the reservoirs and ponds, 'nay, every ditch and little plash of water but ankle-deep, hath fish in it.' But many of these reservoirs and tanks are, twice in each year, liable to be evaporated to dryness, till the mud of the bottom is converted into dust, and the clay cleft by the heat into gaping apertures. Yet, within a very few days after the change of the monsoon, the natives are busily engaged in fishing in those very spots and in the hollows contiguous to them, although entirely unconnected with any pool or running streams, in the way in which Knox described nearly 200 years ago, with a funnel-shaped basket, open at bottom and top, which, as he says, they 'jibb down, and the end sticks in the mud, which often happens upon a fish; which, when they feel beating itself against the sides, they put in their hands and take it out, and reeve a ratan through their gills, and so let them drag after them.'

"This operation may be seen in the lowlands which are traversed by the high road leading from Colombo to Kandy, the hollows on either side of which, before the change of the monsoon, are covered with dust or stunted grass; but when flooded by the rains, they are immediately resorted to by peasants with baskets, constructed precisely as Knox has stated in which the fish are encircled and taken out by the hand.

"So singular a phenomenon as the sudden reappearance of full-grown fishes in places which a few days before had been encrusted with hardened clay has not failed to attract attention; but the European residents have been contented to explain it by hazarding the conjecture, either that the spawn had lain imbedded in the dried earth till released by the rains, or that the fish so unexpectedly discovered fall from the clouds during the deluge of the monsoon.

"As to the latter conjecture, the fall of fish during showers, even were it not so problematical in theory, is too rare an event to account for the punctual appearance of those found in the rice-fields at stated periods of the year. Both at Galle and Colombo, in the south-west monsoon, fish are popularly thought to have fallen from the clouds during violent showers; but those found on the occasions that give rise to this belief consist of the smallest fry, such as could be caught up by water-spouts and vortices analogous to them, or otherwise blown on shore from the surf; whereas, those which suddenly appear in the replenished tanks, and in the hollows which they overflow, are mature and well-grown fish. Besides, the latter are found, under the circumstances I have described, in all parts of the interior, whilst the prodigy of a supposed fall of fish from the sky has been noticed, I apprehend, only in the vicinity of the sea or of some inland water."

The surmise of the buried spawn is one sanctioned by the very highest authority. Mr. Yarrell, in his "History of British Fishes," adverting to the fact that ponds which had been previously converted into hardened mud are replenished with small fish in a very few days after the commencement of each rainy season, offers this solution of the problem as probably the true one:—"The impregnated ova of the fish of one rainy season are left unhatched in the mud through the dry season, and from their low state of organisation as ova, the vitality is preserved till the recurrence and contact of the rain and oxygen in the next wet season, when vivification takes place from their joint influence."

This hypothesis, however, appears to have been offered upon imperfect data; for although some fish, like the salmon, scrape grooves in the sand and place their spawn in inequalities and fissures, yet, as a general rule, spawn is deposited, not beneath, but on the surface of the ground or sand, over which the water flows, the adhesive nature of each egg supplying the means of attachment. But in the Ceylon tanks, not only is the surface of the soil dried to dust after the evaporation of the water, but the earth itself, twelve or eighteen inches deep, is converted into sunburnt clay; in which, although the eggs of mollusca, in their calcareous covering, are in some instances preserved, it would appear to be as impossible for the ova of fish to be kept from decomposition as for the fish themselves to sustain life. Besides, moisture in such situations is only to be found at a depth to which spawn could not be conveyed by the parent fish by any means with which we are yet acquainted.

But supposing it possible to carry the spawn sufficiently deep, and to deposit it safely in the mud below, which is still damp, whence it could be liberated on the return of the rains, a considerable interval would still be necessary, after the replenishing of the ponds with water, to admit of vivification and growth. But, so far from this interval being allowed to elapse, the rains have no sooner ceased than the fishing of the natives commences, and those captured in wicker cages are mature and full-grown, instead of being "small fish" or fry, as affirmed by Mr. Yarrell.

Even admitting the soundness of his theory, and the probability, under favourable circumstances, that the spawn in the tanks might be preserved during the dry season so as to contribute to the perpetuation of their inhabitants, the fact is no longer doubtful that adult fish in Ceylon, like some of those that inhabit similar waters in the New and Old Worlds, have been endowed with the singular faculty of providing against the periodical droughts, either by journeying overland in search of still unexhausted water, or, on its utter disappearance, by burying themselves in the mud to await the return of the rains.

The class of Fishes may be, in uniformity with Dr. Günther's invaluable Catalogue, divided into the following sub-classes and orders :—

Sub-class.	Order.	Sub-class.	Order.
I. Teleostei	1. Acanthopterygii.	III. Ganoidei	8. Holostei.
	2. Pharyngognathi.		9. Chondrostei.
	3. Anacanthini.		
	4. Physostomi.	IV. Chondropterygii	10. Holocephala.
	5. Lophobranchi.		11. Plagiostomata.
	6. Plectognathi.	V. Cyclostomata	12. Marsipobranchii.
II. Dipnoi	7. Sirenoidei.	VI. Leptocardii	13. Cirrhostomii.

SUB-CLASS 1.—TELEOSTEI, OR BONY FISHES.

The fishes of this sub-class may in great measure be regarded as types of the class. They are all furnished with a more or less perfect bony skeleton; the gills are supported on free bony arches, and the water from the gills passes away from them by a single aperture, which is protected by a bony operculum or gill cover. Some of them have naked skins; in very many scales (either cycloid or ctenoid) are present; in some these form a bony armour.

ORDER I.—ACANTHOPTERYGII.

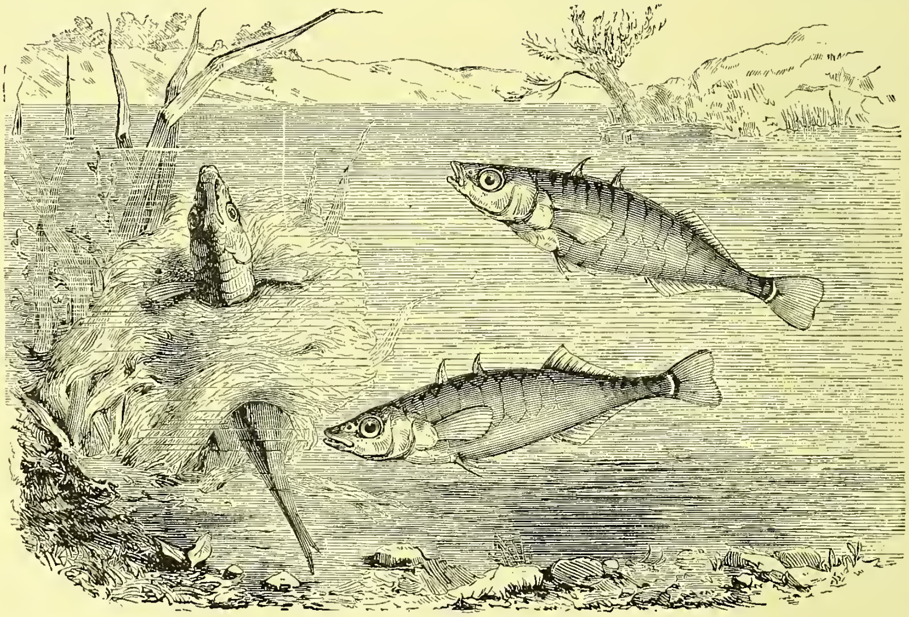
This order contains those spiny-finned fishes in which the lower bones of the pharynx are distinctly separated. The rays of the first dorsal fin are spinous, often forming quite formidable weapons. The ventral fins are generally situated near to the pectoral fins; and the air bladder, when present, has no air duct.

The family of the Sticklebacks, or Gasterosteidæ, contains a number of species. Some are found in fresh water, and some are marine. Their sides are more or less protected with bony plates, but otherwise they are destitute of scales. The Three-spined Stickleback (*Gasterosteus aculeatus*) is the most common species, and is distinguished by the body being protected at the sides with shield-like plates, and the possession of three spines on the back. It is of an olive-colour above, and silvery white beneath, and varies from two to three inches in length. In the breeding season, the male assumes a pink hue on the under parts of the body, and the general colour of the upper parts is brighter, and often green. According to Bloch, this species spawns in April and June, and, according to Cuvier, in July and August.

The Fifteen-spined Stickleback (*G. spinachina*), according to Mr. Couch, "keeps near rocks and stones clothed with sea-weeds, among which it takes refuge upon any alarm. Though less active than its brethren of the fresh water, it is scarcely less rapacious. On one occasion, I noticed a specimen, six inches in length, engaged in taking its prey from a clump of sea-weed, in doing which it assumed every posture between the horizontal and perpendicular, with the head downward or upward, thrusting its projecting snout into the crevices of the stones, and seizing its prey with a spring.

"Having taken this fish with a net, and transferred it to a vessel of water, in company with an eel of three inches in length, it was not long before the latter was attacked and devoured head foremost—not, indeed, altogether, for the eel was too large a morsel, so that the tail remained hanging out of the mouth ; and it was obliged at last to disgorge the eel partly digested. It also seized from the surface a moth that fell on the water, but threw up the wings. The effect of the passions on the colour of the skin in the species of this genus is remarkable; and the specimen now spoken of, under the influence of terror, from a dark olive with golden sides, changed to pale for eighteen hours, when it as suddenly regained its former tints. It spawns in spring, and the young, not half an inch in length, are seen in considerable numbers at the margin of the sea, in summer."

Nearly thirty years ago, the following remarks were made by an intelligent observer, unacquainted with Natural History as a science, and who was not aware of what was then being closely studied by others on a kindred species:—"In a large dock for shipping on the River Thames thousands of pricklefish were bred some years ago, and I have often amused myself for hours by observing them. While multitudes have been enjoying themselves near the shore in the warm sunshine, others have been busily engaged in making their nests—if a nest it may be called. It consisted of the very minutest pieces of straw or sticks, the exact colour of the ground at the bottom of the water, on which it was laid, so that it was next to an impossibility for any one to discover the nest, unless they saw the fish at work, or observed the eggs.



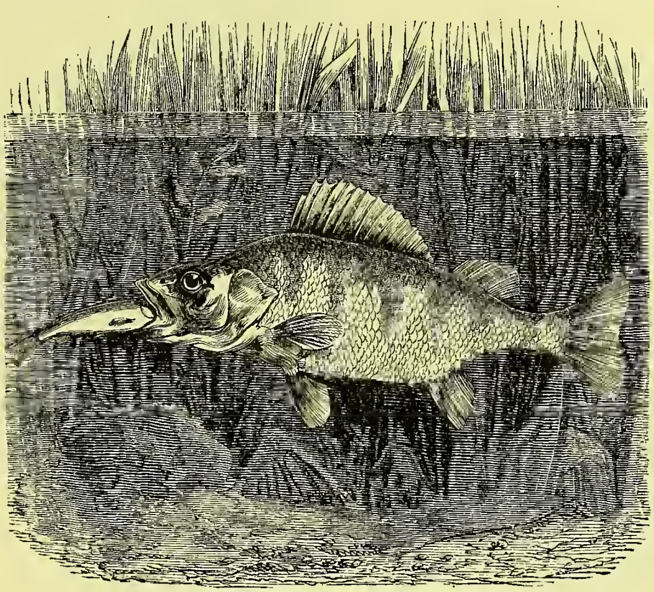
STICKLEBACKS AND NEST.

"The nest is somewhat larger than a shilling, and has a top or cover with a hole in the centre, about the size of a very small nut, in which are deposited the eggs or spawn. This opening is frequently concealed by drawing small fragments over it; but this is not always the case. Many times have I taken up the nest, and thrown the eggs to the multitude around, which they instantly devoured with the greatest voracity. These eggs were about the size of poppy-seeds, and of a bright yellow colour; but I have at times seen them almost black, which I suppose is an indication that they are approaching to life. In making the nest I observed that the fish used an unusual degree of force when conveying the material to its destination. When the fish was about an inch from the nest, it suddenly darted at the spot, and left the tiny fragment in its place, after which it would be engaged for half a minute in adjusting it. The nest, when taken up, did not separate, but hung together like a piece of wool."

Many years after this statement was made, M. Costa gave great attention to the habits of the stickleback. He watched the whole process of the construction of the nest, the laying of the eggs by the female, and the care taken of them by the male. He says: "The stickleback has the foresight to cover the nest heavily with sand, to prevent its being swept away by the waters; and they glue together the materials of which the nest itself is composed by means of the mucous excretion which exudes from their bodies. To make sure that all parts of the nest are united with sufficient solidity, the fish suspends himself in the water immediately above it, with his head downwards, and makes rapid vibrations with his pectoral fins and his tail. By this means, any parts of his dwelling which are not properly constructed at once become loose and detached, and he instantly darts down and repairs the defect.

"During an entire month he is the sole guardian of the eggs which the females lay within, and he has to defend them, not only against the attacks of other fishes, but against the ferocious and unnatural appetites of the sticklebacks themselves. He removes the stones which accumulate at the mouth of the nest, he enlarges the opening, and by the singular vibrations of his tail and fins, he changes and purifies the water in the neighbourhood, and in short he never relaxes his care of the young until they are fully able to provide for themselves."

Of the PERCHES, OR PERCIDÆ, we must mention the Common Perch (*Perca fluviatilis*). It is one of the most beautiful of our fresh-water fishes. The upper part of the body is of a rich greenish-brown, passing below into hues of a golden yellowish-white. The common perch is the type of a family consisting of numerous genera, some (Serranus, Apogon) inhabiting the sea. Their geographical distribution is so extensive as to comprise the most opposite parts of the globe; as, for example, North America, Java, and New Zealand. There are few rivers, streams, lakes, canals, or ponds in England in which perch may not be found; though, like the trout, it probably prefers clear and rapid streams, and haunts the moderately deep waters and hollows under the banks. It is a sociable fish, and swims in shoals.



THE PERCH (*Perca fluviatilis*).

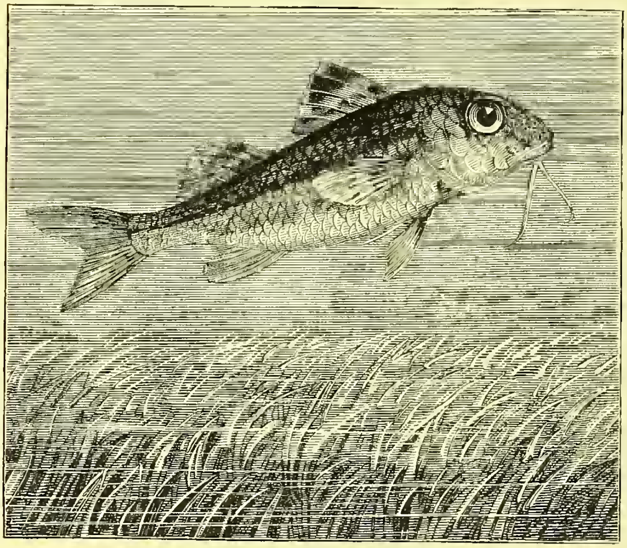
In a piscatorium formed by Mr. Jesse, at Bushey Park, he says, "The perch were the boldest and most familiar of any of the fish, as I found no difficulty in soon getting them with eagerness to take a worm out of my hand." Mr. Yarrell states that perch have been known to breed in a small vase.

Like the carp, it possesses great tenacity of life when out of its natural element, and bears easily a journey of forty or fifty miles, if refreshed occasionally with water, and placed in wet moss. In some parts of the Continent the fish is taken from the ponds in the morning, carried to market, and if not sold, is restored to its proper element and home at night.

The Sandar (*Lucioperca sandra*) is a native of the Spree, and one of the most delicious fishes of Europe; it often attains a length of four feet. Perhaps the best known of the marine species is the Sea Perch, or Basse (*Labrax lupus*). It is largely used as an article of food.

The MULLETS, OR MULLIDÆ, form a large salt-water family, chiefly found in the tropical seas, but said not to be found on the west coast of America. Two species are found on the British coasts. One, the well-known mullet of the ancients (*Mullus barbatus*), is a very rare British fish. It was held in greater esteem in ancient than it is in modern times; for it was a common proverb, that he who took one never ate it, the high price which it bore being an inducement to hurry with it to the best market, where it fetched, it is said, as much as its weight in silver; and there even arose contentions among epicures as to who should become the purchaser. A sum equivalent to £240 was once given for three of more than ordinary size, which happened to be in the market just before a banquet of unusual magnificence, and it is stated by Martial, that the cost of a mullet of about four pounds and a half was still higher, and the price rose at each successive increase of weight.

Mullets were often brought alive in glass vases to table, and a barbarous pleasure was derived from witnessing the changes of colour they underwent in expiring. Apicius invented a mode of suffocating the mullet in a kind of pickle; and Seneca endeavoured to put an end to these practices, disgraceful to a people who stood the foremost in civilisation. The roe of the mullet is used in Italy for the purpose of making a preparation which acts as a stimulus to the appetite. It is taken out whole, and covered with salt for about five hours, and is then pressed, but not strongly, between two boards. It is subsequently washed, and afterwards exposed to the sun, when it becomes fit for use.



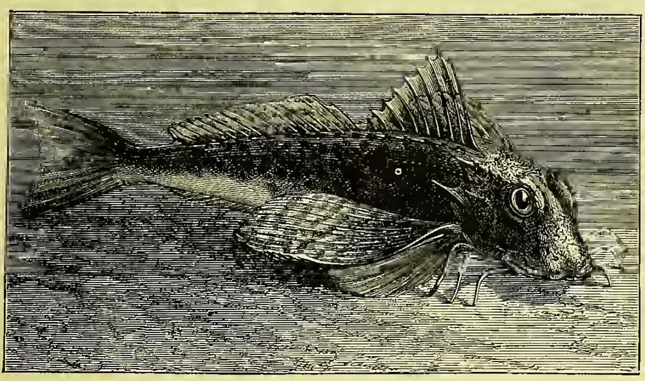
THE RED MULLET (*Mullus barbatus*).

The Striped Red Mullet (*Mullus surmuletus*) is taken often in great numbers along the whole length of our southern shores. On other parts of the coast it is comparatively rare. It seldom exceeds fourteen inches in length. A specimen is mentioned which weighed 3 lbs. 6 ozs., and was in high perfection. When the colours are finest the fish is in the best condition; and they are also most abundant at that time, usually the months of May and June. In places where the scales have not been forcibly removed, the colour is a pale pink, which may be regarded as the natural colour of the fish. Spring is the season for spawning, and towards October the young are above the length of a man's finger. They are caught in mackerel nets, and in larger quantities in trawl nets. They feed near the bottom, and are provided with appendages articulated to the mouth, and which Mr. Yarrell found on examination to consist of numerous longitudinal muscular and nervous fibres. He says: "These appendages are to them, I have no doubt, delicate organs of touch, by which all the species provided with them are enabled to ascertain, to a certain extent, the qualities of the various substances with which they are brought in contact, and are analogous in function to the beak, with its distribution of nerves, among certain wading and swimming birds, which probe for food beyond their sight; and may be considered another instance, among the many beautiful provisions of nature, by which, in the case of fishes feeding at great depths, where light is deficient, compensation is made for consequent imperfect vision."

The Gurnards, or Triglidæ, are a family of carnivorous marine fish, living very much at the bottom of the sea. The Red Gurnard (*Trigla cuculus*), often called the Cuckoo Gurnard, from the similarity of the sound it makes to that of the cuckoo, is very common on the British coasts. Like the rest of the species, it swims near the bottom, and feeds on crustacea, and when captured is very tenacious of life. It is in the greatest perfection during the winter months, and seldom exceeds twelve or fourteen inches in length. This fish is mostly taken in trawl nets, as it swims low; it will, however, bite freely, and may be caught by means of hand-lines, the hooks being baited with any silvery shining fish, as a piece of the sand-lance.

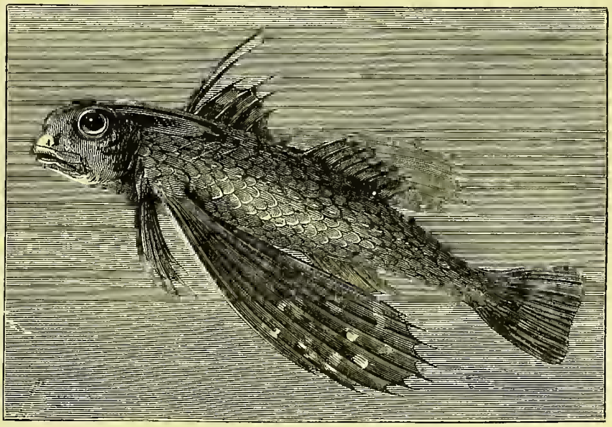
The Sapphirine Gurnard (*Trigla hirundo*) is nearly as common as the former, and exceeds it in size, often measuring from eighteen inches to two feet in length. Its general colour is a brownish-red; the inner surface of the pectoral fins is of a fine blue; the head is large and flat. Its flesh is excellent, when properly cooked, that is, stuffed, roasted, and served up with rich sauce or brown gravy. On the boards of the fishmongers' shops this fish may be commonly seen, with its large pectoral fins spread out or tied together over its head, giving it a curious appearance.

This fish is taken by means of the trawl net, in deep water. This net is long and conical, being from sixty to seventy feet in extent, with a square mouth of eighteen feet in breadth. It is dragged along by means of a rope, from a sailing boat of ten or twelve tons burden. In some parts, however, the trawling nets used are far larger, and the vessels are of seventy or eighty tons burden, and cutter-rigged.


THE GURNARD (*Trigla hirundo*).

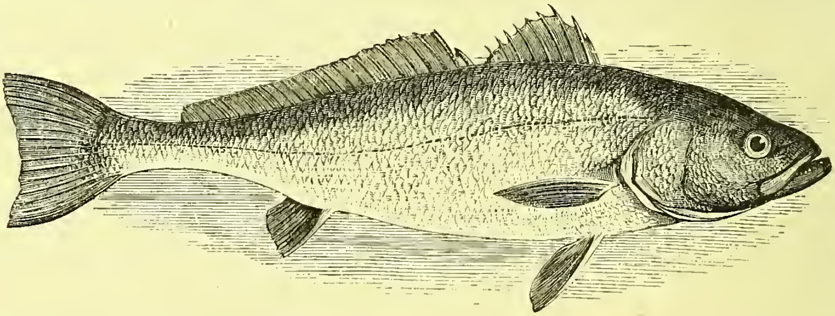
Another very remarkable species is the Flying Gurnard (*Dactylopterus volitans*), which inhabits the Mediterranean. It varies from one foot to fifteen inches in length, and is of a brown colour above, with spots of a deeper tint; the sides of the body are red, and the under parts are of a pale rose colour. The large pectoral fins are of a blackish tint, mottled and spotted with blue; the ventral and anal fins are of a rose colour; the anterior dorsal is grey, with clouded markings of a deeper hue; the posterior dorsal is transparent, and its rays are of a pale colour spotted with brown.

The MAIGRES, OR SCIÆNIDÆ, are both marine and fresh-water fishes, covered with toothed scales. The Maigre (*Sciæna aquila*) is found now and then on our own coasts, but it abounds in the Mediterranean, and is esteemed good food. At Genoa, it is termed *fegaro*, and at Nice, *figou* and *vanloo*. The maigre is gregarious in its habits, swimming in shoals. It utters a purring noise so loud as to be heard from a depth of twenty fathoms; and from this circumstance the fishermen are often enabled to take several in their net with certainty, their noise betraying their exact locality. Their capture, however, is not a very safe or easy task, for the maigre is from three to six feet and upwards in length, very strong and resolute, and it struggles with the utmost desperation, knocking the men about, till one of them can manage to strike it a heavy blow on the head, and so deprive it of life. "Rondeletius," observes Mr. Yarrell, "calls this species *peis rei* (royal fish). It appears always to have been in great request with epicures; and as, on account of its large size, it was always sold in pieces, the fishermen of Rome were in the habit of presenting the head, which was considered as the finest part, as a sort of tribute to the three local magistrates, who acted for the time as conservators of the city." It is the umbrina of the ancient Romans, and is generally of a silver-grey colour, inclining to brown on the back, and pure silver on the under parts. The fins are reddish. There are two dorsal fins.


THE FLYING GURNARD (*Dactylopterus volitans*).

The large family of the CHÆTODONTIDÆ chiefly contains marine fishes. Their bodies are very compressed, and often the scales mount upon and nearly cover the fin rays. They are generally of small or moderate size, and most of them are inhabitants of the tropical seas. They are remarkable for the exceedingly magnificent colours with which they are generally adorned, and which are rendered still more pleasing to the eye by the broad black bands which, in most cases, traverse the body from the dorsal to the ventral margin. One of these bands generally passes down the region of the eye.

The flesh of these fishes is said to be exceedingly delicate and well flavoured. Only a single species (*Brama raii*) inhabits the British seas, where it is by no means common, although in the Mediterranean it occurs in great abundance. It is said to measure two feet six inches in length; but one mentioned by Yarrell did not exceed sixteen inches. Its flesh is highly esteemed. A singular species, the Chelmon rostratus, inhabiting the Chinese seas, has the jaws very much prolonged, forming a sort of beak, but so enclosed in the skin that only a small opening is left at its extremity for the mouth. This fish is said to exhibit a very curious instinct; it projects a drop of water from its mouth at any insect that it perceives within reach of such a missile, so as to bring it down into the water, where, of course, it falls an easy prey to its dexterous assailant. The Chinese keep these fishes in basins, and amuse themselves by watching their efforts to bring down a fly suspended over them by a thread. A Javanese species, the Toxotes jaculator, which has a wide mouth with the lower jaw considerably prolonged, exhibits the same singular instinct. It is said to throw the water to a height of three or four feet, and rarely to miss its aim.



THE MAIGRE (*Sciæna aquila*).

The MACKERELS, OR SCOMBERIDÆ, are all marine fishes, and include a number of most valuable species. Perhaps the best known is the Mackerel (*Scomber scomber*). The name given to the mackerel by the French, German, and Dutch, as well as by the English, is derived from the Latin word *macula*, a spot; that is, the spotted or streaked fish. Hence the term "mackerel-sky" is often applied to a well-known arrangement of the clouds.

The mackerel is, perhaps, the most beautiful of our British fishes, being elegant in its form as well as brilliant in its colour. The back is varied with hues of fine green and rich blue, and is marked by broad transverse lines of a dark colour. "The males," says Donovan, "have these dark transverse bands nearly straight; while in females these bands are elegantly undulated." The colours are much richer when the fish is first taken out of the water; but even when exhibited on fishmongers' stalls they are still brilliant. The scales are small and smooth; while some of the posterior rays of the second back, and the caudal or tail-fin, form very small-sized fins. The weight of the mackerel is generally under two pounds; but Pennant mentions one sold in London which weighed five pounds and a quarter. The ordinary length is fourteen or sixteen inches, but some are found of the length of twenty inches.

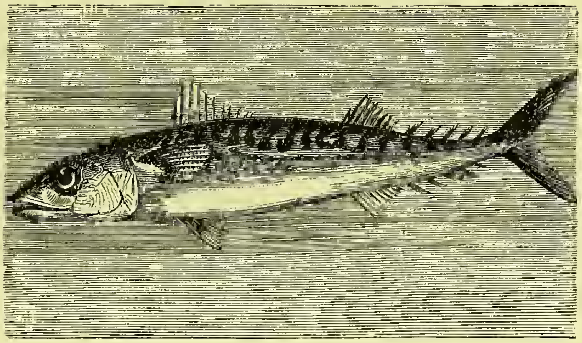
A light gale, which gently ripples the surface of the water, and is called a mackerel gale, is most favourable to the fisherman, who chiefly follows his employment during the night. There are three modes of fishing: with drift-nets, with seines, and with the line. By the latter mode a couple of men will take from 500 to 1,000 mackerel in one day, if the weather be favourable. The French boats frequently go out with six or eight people on board, all of whom fish with the line; and some of them are sufficiently adroit to pay attention to a couple of lines at the same time.

Few of these fishes are salted in England, but in France great numbers are used thus prepared. The spring fishing-boats carry out salt with them for this purpose, and cure the fish on board. Young mackerel of the year are called "shiners." Excluded from the egg in May or June, they increase rapidly in size, and by the middle of autumn are from four to six inches long. On the approach of winter they retire to deep water.

A Dutch auction may sometimes be witnessed on the beach of an active fishing town. The mackerel are separated into heaps as soon as they are landed; and the persons desirous of purchasing being assembled, one of the fishermen or owners of the boat acts as salesman, and names a price above the real value, while he raises a large stone with which to "knock down" a lot. A lot, which may ultimately sell at forty shillings, is offered at sixty shillings, the salesman rapidly naming a lower price until he gets a bid, when the stone falls to the ground, and the first bidder becomes the purchaser. This descending instead of an ascending scale enables the sellers to get through their work more quickly, and it is, perhaps, the fairer, for the price approaches nearer the actual worth than when feelings of rivalry are allowed to display themselves.

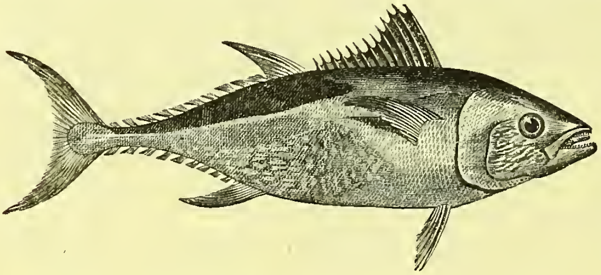
Another important fish is the Tunny (*Thynnus vulgaris*), and we take the following account of a tunny fishing from Quatrefages:—

"At all events, the tunny is undoubtedly a very great source of wealth to the shores which it frequents. Either fresh, salted, or smoked it is an object of commerce, which annually leads to the circulation of thousands of thousands; and hence this fish has at all times been the object of remorseless pursuit. Aristotle, Pliny, Athenæus, and Oppian, have all transmitted to us details of the different methods employed by the ancients for its capture. Since then, every age and every people seem to have furnished their contingent of murderous inventions. The most formidable means devised for capturing this unfortunate fish is undoubtedly the madrague, which is said to have been first employed by the inhabitants of Martigues. This apparatus is not merely the libouret of the Bayonnese, or the grand couple of the Basque fishermen, which are gigantic lines carrying many hundred baited hooks, and which are worked by a boat's crew of eight or ten men; nor is it like the courantille of the Provence fishermen, for this contrivance is merely a kind of seine, from 1,500 to 2,000 feet in length, which is often thrown over a space measuring more than six or eight miles across. The madrague is an actual park, with its walks and alleys all terminating in a vast labyrinth, composed of chambers, which open into one another, and all of which lead to the chamber of death, or the corpon, which is situated at the extremity of the structure. This vast enclosure, the walls of which sometimes extend upwards of three miles, is both secured and raised by means of immense lines and nets weighted with stones, supported by cork buoys, and secured with anchors in such a manner as to resist the most violent storms to which it would be exposed during the usual fishing season. It may easily be conceived that the materials constituting an apparatus of this kind are of enormous size and bulk; on this account, a steam-boat is chartered every year to convey the entire apparatus from Palermo to Favignana. The arm of the sea which lies between this island and Levanyo is peculiarly well adapted for the establishment of a tonnara, as the Sicilians call it, and the right of fishing in this locality alone is valued at 60,000 francs.



THE MACKEREL (*Scomber scomber*).

"When first we arrived at Toire dell' Isola, we saw this steamer on her way to Favignana, and from that time till we landed on the island, men had been continually at work in fixing the madrague. It was now completed, and some tunnies had already been seen within the first compartments of the apparatus. We had a great desire to witness one of these fishings, of which Joseph Vernet's picture gives a tolerably good idea. The reports of our own sailors, whose eyes sparkled at the very mention of the word "tonnara," had increased our anxiety to be present on one of these occasions, which are regarded by the inhabitants of the Sicilian islands in the light of festivals. Signor Bartholini kindly undertook to inform us of the time at which we were to hold ourselves in readiness to join the other boats engaged in the fishing, and we lost no time in obeying his directions. One morning, on looking out, we saw that flags had been raised on every elevated point of the island to serve as signals for calling together the fishermen of the neighbourhood to take part in the tonnara. Scarcely any, I believe, failed to appear at the common rendezvous. Every barque between Irapani and Mazara had hoisted her sails, and by the break of day, far as the eye could reach, the sea seemed to be covered with a moving fleet of sailing-boats, whose hundred broad lateen sails, converging to one and the same point, presented the most picturesque appearance. The *Santa Rosalia* was soon in the midst of this numerous flotilla; and by the energetic efforts of our sailors, whose strength and activity seemed to be doubled for the occasion, we reached the madrague in good time to follow all the scenes of the sanguinary drama which was about to be enacted.



THE TUNNY (*Thynnus vulgaris*).

"If any of our readers should deem these expressions exaggerated, we would beg them to come and judge for themselves, and embark with us on board one of those large boats which, in the midst of the sea, have combined to enclose a space of about one hundred square feet. Between 500 and 600 tunnies, impelled from chamber to chamber by the valves which close behind them, have at length reached the last compartment, or the chamber of death. This enclosure is provided with a movable floor formed of netting, which can be raised from the bottom to the surface of the water by means of ropes. All night long men have been labouring to lift the huge apparatus, little by little, and now each of its margins rests upon one of the sides formed by the boats. Facing us is the proprietor of the fishery, surrounded by his staff and by a charming group of ladies, who have come from Palermo to witness the spectacle which is about to be exhibited. To the right and to the left are stationed the two principal boats, which convey the band of fishermen. These boats, which are entirely empty, lie ready to receive their cargo; the only thing that breaks the even line of their decks being a long beam, which passes from one extremity to the other, and leaves a narrow sort of gangway on the edge of the boat, where stand at least two hundred fishermen, who have come, in some cases, from a distance of more than fifty miles to take part in this exciting sport. Half-naked, with deeply-bronzed limbs, these athletic men stand side by side, all awaiting, with the same eager impatience, the moment of action. Their eyes are sparkling beneath their scarlet Phrygian caps; their hands are grasping the instruments of death—broad, sharp, and cutting hooks, which are either inserted into a long pole, or fitted to the end of a short massive handle, which is deeply cut to enable the hand to obtain a firmer hold of the weapon. In the midst of the enclosure, a little black rowing-boat, manned by two oarsmen, contains the master-fisherman, from whom emanate all orders, and who is ever at hand to encourage and lead on the workmen, or to carry reinforcements from side to side, as they may be needed.

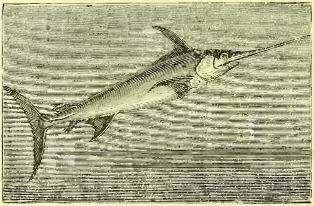
"During all this time the capstans, which are fixed at the extremities of the net, have never ceased turning; and as the moving floor of the corpon gradually rises, the tunnies begin to appear, and on looking through the transparent water we see the fish darting uneasily from one side to the other of a vast enclosure in which they are imprisoned. Some of them rise to the surface or even spring out of the water; but woe be to those who rise near one of the boats! for no sooner does the fish appear than hands of iron are stretched forth to bury their sharpened points in its sides. Even though they may be wounded, the fish generally escape from the first attack: for being full of life and strength, and in the enjoyment of entire liberty of motion within the large basin that encloses them, they tear themselves from the hands of their enemies, leaving only a few bleeding shreds of flesh attached to the hooks; but still the capstan turns remorselessly to the modulated songs of the sailors, and the net rises higher and higher. The master-fisherman is always at hand in his little boat to drive the tunnies toward the edges of the net. Wounds are now dealt on every side; and soon some fish, more deeply struck than his companions, slackens his course, showing from time to time his broad silvery sides, along which the black blood is streaming forth. At every new stroke his resistance diminishes, and soon the victim pauses for an instant; but that instant is enough; a dozen hooks are at once buried in his flesh, a dozen arms are bent to lift him to the surface of the water. In vain the skin has given way: each hook that loses its hold is raised on high only to be buried still deeper in the quivering flesh, and soon the unfortunate animal is drawn to the side of the boat. In another moment he is seized by two men, who, each grasping one of his large pectoral fins, lift him to the beam, which is placed behind them, and throw him into the hold.

FISHING FOR TUNNIES.

"But the net is always remorselessly rising, and now the entire shoal of tunnies is exposed to view. Pressed close to one another, these monster fishes are throwing themselves in despair against the flexible walls of the corpon; at one moment showing their black yellow-spotted backs, at another moment cleaving the surface of the water with their large crescent-shaped fins. Here and there a few sword-fish, with their long pointed snouts, may be seen interspersed among the tunnies. Animated by the sight of the victims which lie exposed to their attack, the sailors strike with redoubled force, and the fishing becomes a massacre. One can no longer individualise the separate actors in this drama; the serried crowd seems to be composed of nothing but violently moving heads, bleeding arms, which rise and fall, and harpoons, which flash and cross one another as they are hurled against the victims. All eyes are sparkling, all lips are uttering cries of triumph, clamour, and encouragement. The waters of the corpon are tinged with blood, and every moment another fish has been hurled across the beam; the dead and the dying lie heaped together in such vast multitudes, that the hulls of the boats are almost hidden beneath the load of their half-living cargoes.

"After two hours of carnage, symptoms of exhaustion begin to appear; the tunnies come but rarely to the surface, and at length their enemies begin to lose patience. A boat is then loosened from either side of the enclosure, and the two principal barques are brought within half their former distance of one another. The capstans are now again brought into play, the impatient fishermen all lend a hand, and now the hooks are inserted in the meshes of the net; but these efforts, which are somewhat irregular, do not at first produce any great results. Soon, however, the master-fisherman's whistle is heard: at once the men break into a song of measured rhythm, their movements become more regular, and pulling in unison with the words which they sing, the net is made to rise higher and higher. Soon it is almost on a level with the surface of the water, and now it is time to resume the labour in earnest. The master-fisherman's boat now, for the first time, takes an active part in the labours of the day. Its crew of picked men pursue the tunnies within the narrow limits to which they are now circumscribed, and striking them with long harpoons, urge them forward against the hooks which are projected from the boats, and which speedily secure them.

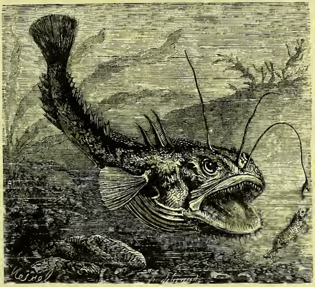
"I must confess that this spectacle, which we had so anxiously desired to witness, left us melancholy and discontented, for we had been most painfully affected by the exhibition of such wholesale butchery. Perhaps the impression produced on our minds would have been different if the fishermen had had a shadow of danger to encounter, or if the tunnies had been able to offer the slightest resistance in their struggles for freedom; and it seemed to us impossible to avoid feeling the deepest emotion in witnessing so unequal a strife, and in observing the mute anguish in which the convulsive movements of the victims were the only indications of the agony which was so wantonly inflicted upon them. It was quite different with our sailors, who were perfectly radiant with delight. As fishermen, they could only see and judge of things after the fashion of their calling, and the fishing had been superb. In three hours 554 fish had been harpooned, weighing on an average 176 lbs. Besides this, the chambers of the madrague still contained about 400 captives; the proprietor might, therefore, count, at the very beginning of the season, upon having caught about seventy tons of the tunny fish, which would, at the least, be equivalent to the sum of 43,000 francs (£1,720). Here, then, in one fishing, nearly enough had been gained to pay the whole expenses of the tonnara."



THE SWORD FISH (*Xiphias gladius*).

The SWORD FISHES, OR XIPHIDÆ, are marine fishes, with an upper jaw shaped like a sword. The Sword Fish (*Xiphias gladius*) is an inhabitant of the Mediterranean and Atlantic, occasionally visiting our coast. It measures from ten to fifteen feet in length, of which the sword forms three-tenths. Its body is lengthy, and covered with minute scales, and on its back is a single long elevated dorsal fin. The lower jaw is sharp, the mouth without teeth. The upper part of the fish is bluish-black, merging into silver below. The young fish is said to be good eating. When very young, the body is covered with small tubercles, which disappear before it attains the length of three feet.

The Xiphias is mentioned by Aristotle, who notices the fact of its striking vessels. The sword-fish, as we call it, is said to attack the whale, wounding it with its beak. There are many well-authenticated instances of the planks of ships being perforated by this powerful creature, which, it has been supposed, occasionally attacks the hulls of ships in mistake for the whale. Specimens of ships' timbers penetrated by its sword are preserved in many museums.


THE ANGLER (*Lophius piscatorius*).

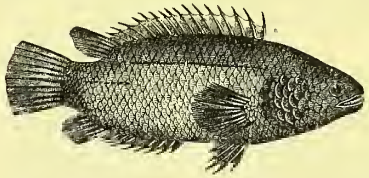
Space compels us to pass over, without detailed reference, the families of the Gobies (GOBIIDÆ), containing such genera as Gobius, Periophthalmus, Callionymus, Cyclopterus, and of the Blennies (BLENNIDÆ), with the genus Blennius, some species of which are very fond of creeping out of rock-pools, and hiding themselves under seaweeds; and one, the Viviparous Blenny (*Zoarcas viviparus*), brings forth its young alive. The genus Anarrhichas, one native species of which, the Sea Wolf, grows to a length of seven feet (*A. lupus*), and we come to the FISHING FROGS, OR LOPHIIDÆ, which contain salt-water fish with very large heads. One species is a native (*Lophius piscatorius*). This curious fish has the head wide, and the mouth nearly as wide as the head; the eyes are large; the lower jaw which is the longer, is bearded or fringed all round the edge; and both jaws are armed with numerous teeth; the body is narrow, compared with the breadth of the head, and tapers gradually to the tail. The colour of the upper surface of the body is uniform brown; the under surface of the body, the ventral and pectoral fins white, and the tail almost black. On the top of the head are three long filaments; of these, two are seated just above the muzzle, the other rises from the back of the head. These filaments are movable in all directions, especially the first, which, tapering like the finest fishing-rod, ends in broad, flattened, silvery tips. The pectoral fins are broad and thick, and serve the place of feet, the ventral fins are placed far anterior to them on the body.

The angler is insatiably voracious, but it is a slow swimmer; it is formed, in fact, for taking its prey in ambush. It reposes on the soft mud or sand, in some favourable lurking-place, and, stirring up the mud with its pectoral fins, thus obscures itself in a murky cloud, beyond which appear its long filaments, and, especially the first, with its glittering tip, offering an attractive bait to other fish. Thus stationed, this creature quietly expects its victim. On rove the shoals of fish, eager in quest of food. They pass one after another in succession, till at length one espies the bait. Forwards the fish darts, either to examine or seize the expected prize; but at that instant, aided by the broad, feet-like pectoral fins, the watchful angler springs up, and captures his prey.

The family CORNEPHORIDÆ contains one remarkable fish, found in Lake Baikal, a fresh-water lake of Asiatic Russia, at an elevation of nearly two thousand feet, and over a thousand miles from the ocean. This fish (*Cornephorus baicalensis*) in some respects resembles a gadoid fish, but we follow Dr. Günther in placing it here.

The RIBBON-FISH, OR TRACHYPTERIDÆ, are deep-sea fishes, with very much compressed ribbon-like bodies. One species (*Gymnetrus banksii*) is not uncommon in the Mediterranean, and has been cast ashore on the coasts of Britain. It sometimes measures twelve feet in length, while its body is not over two to three inches in thickness. It is of a lovely silver colour.

The family of the LABYRINTHICI must be noticed as containing some fresh-water fish found in China, the East Indies, Mauritius, and South Africa, and some of which, by the assistance of accessory breathing organs, can live for some time out of the water. Perhaps the best known species is the Climbing Perch (*Anabas scandens*), the following account of which is given us by Sir Emerson Tennant:—“Referring to this fish, Mr. Hamilton Buchanan says, that of all the fish with which he was acquainted it is the most tenacious of life; and he has known boatmen on the Ganges to keep them for five or six days in an earthen pot without water, and daily to use what they wanted, finding them as lively and fresh as when caught. Two Danish naturalists, residing at Tranquebar, have contributed their authority to the fact of this fish ascending trees on the coast of Coromandel, an exploit from which it acquired its epithet of scandens. Daldorf, who was a lieutenant in the Danish East India Company's service, communicated to Sir Joseph Banks that in the year 1791 he had taken this fish from a moist cavity in the stem of a Palmyra palm, which grew near a lake. He saw it, when already five feet above the ground, struggling to ascend still higher; suspending itself by its gill-covers, and bending its tail to the left, it fixed its anal fin in the cavity of the bark, and sought, by expanding its body, to urge its way upwards, and its march was only arrested by the hand with which he seized it.



THE CLIMBING PERCH.

“There is considerable obscurity about the story of this ascent, although corroborated by M. John. Its motive for climbing is not apparent, since water being close at hand it could not have gone for sake of the moisture contained in the fissures of the palm; nor could it be in search of food, as it lives, not on fruit, but on aquatic insects. The descent, too, is a question of difficulty. The position of its fins, and the spines on its gill-covers, might assist its journey upwards, but the same apparatus would prove anything but a facility in steadying its journey down. The probability is, as suggested by Buchanan, that the ascent which was witnessed by Daldorf was accidental, and ought not to be regarded as the habit of the animal. In Ceylon I heard of no instance of the perch ascending trees; but the fact is well established that both it, the pullata (a species of Polyacanthus), and others, are capable of long journeys on the level ground.”

THE CLIMBING PERCH.

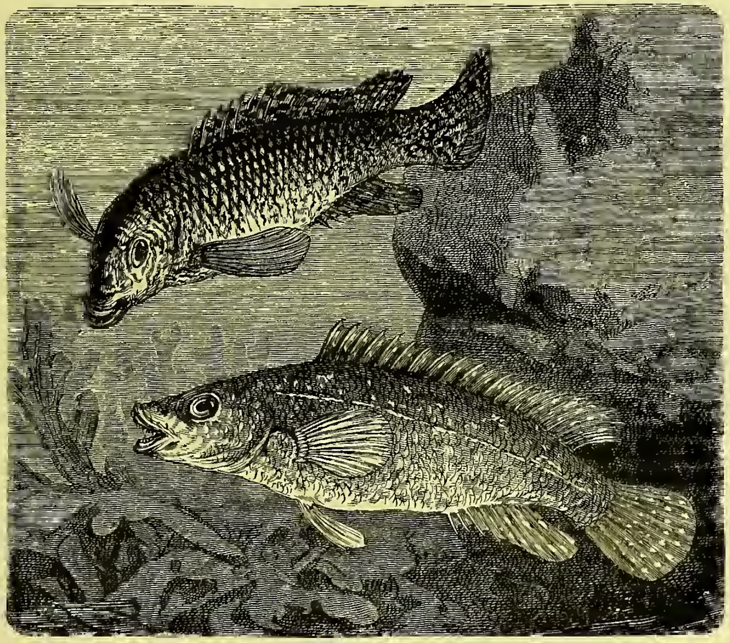
The Sand Smelts, or Atherinidæ, are a small family of marine or fresh-water fish. The Sand Smelt (*Atherina presbyter*) is a handsome small fish common on most of our sandy bays.

The large family of the Grey Mulelts, or Mugilidæ, contains nearly a hundred species, some of which are fresh-water, some marine. Our common Grey Mullet (*Mugil capito*), is a well-known fish, and one much esteemed for its flesh. It seems to be equally at home in fresh and salt water, indeed, it is said that the change from the one to the other is necessary for it. It will at times rise freely at the flies used for trout. It is exceedingly active in the water, and has great power of leaping. On one occasion, as a large seine net was being drawn ashore, the writer was in a boat beating the water at the sea side of the net to frighten the entangled fish on shore, but as a lot of mullet, that were included in the momentarily decreasing area, seemed to become aware of the circumstances of the case, they with one accord turned their tails to the land and their faces to the sea, and sprang high up over the edge of the seine net.

The Band-fishes, or Cepolidæ, form a little family of long red-coloured band-like marine fish, of which one species, the Red Band Fish (*Cepola rubescens*), is not uncommon in the Mediterranean, and has occurred off the coasts of Ireland and Scotland.

ORDER II.—PHARYNGOGNATHI.

This order contains about 700 fishes, which, in a great measure, agree in this, that the inferior bones of their pharynx are completely joined together, so as to form, as it were, a single bone, which is very generally armed with teeth; so complete often is this union that it is impossible to trace out the several bones. Dr. Günther divides it into five families: Pomacentridæ, Labridæ, Embiotocidæ, Gerridæ, and Chromidæ. The first family contains only marine fishes, and these are principally found in warm countries. The second family also contains marine fish, with bodies covered with cycloid scales, with fleshy lip, and formidable teeth in the jaws; some are flesh-eaters, some vegetable feeders. Many of them are beautifully coloured, and the Rainbow Wrasse (*Labrus julis*), though a rare British visitor, may well vie with any tropical fish in the glories of its colours. It is far from uncommon in the Mediterranean. Its back is greenish-blue, with an orange-coloured longitudinal band, beneath which there are lilac bands on a silvery ground; the head is varied with brown, yellow, blue, and silver, while the back fin is orange with a big purple spot. And that common British species the Ballans Wrasse (*L. maculatus*) is also a very beautiful fish. These fishes are, however, not esteemed as good for food.



THE WRASSE (*Labrus maculatus*).

The family Embiotocidæ is only alluded to as containing a few species of marine viviparous fish. A full account of one of these species (*Ditrema argenteum*) will be found in M. Lord's "Naturalist in British Columbia." From twelve to fourteen little fish have been found packed away in the marsupial pouch of the mother fish.

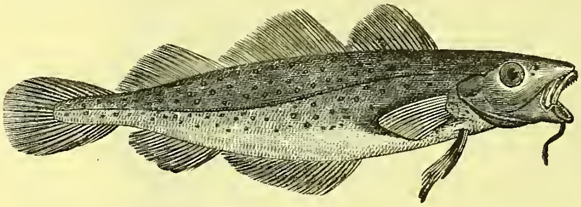
The fishes belonging to the Chromidæ are all fresh-water, and are to be found in the rivers and lakes of Asia, Africa, and tropical America. One species of Chromis (*C. niloticus*) is very common in the river Nile, and is one of the best fishes for the table to be found in Egypt.

ORDER III.—ANACANTHINI.

This order is not more than half as numerous a species as the preceding one, and yet, on account of the commercial value of the fishes contained in it, it is, perhaps, the most important order of all the fishes. The unpaired fin rays are entirely soft. The air bladder is completely closed, not communicating with the gullet; the inferior bones of the pharynx are always separated. In some fishes of the order the ventral fins are wanting, while in others these are placed up under the throat.

The first family we may mention is that of the Gadopsidæ, which is interesting as containing the only fresh-water fish of the order known to exist in Australia and Tasmania. It is there called the Fresh-water Trout (*Gadopsis marmoratus*). Its upper jaw overhangs the lower, forming an obtuse snout.

The Cod family, or Gadidæ, contains some sixty species of marine fishes, chiefly to be met with in the cold and temperate regions of both hemispheres. The most important fish of this family is, perhaps, the Cod (*Gadus morrhua*). It is an inhabitant of cold or temperate climates. It is particularly met with in that part of the Northern Atlantic comprehended between the fortieth and sixty-sixth degree of latitude. It does not exist in the Mediterranean or other interior seas whose entrance is nearer to the equator than the fortieth degree. It appears to be almost entirely confined to the northern parts of the world. Few, however, are taken north of Iceland, but on the south and west coasts they abound, and they are found to swarm on the coasts of Norway and off the Orkneys and Western Isles, after which they decrease in numbers in proportion as we advance towards the south. Cod are never found but in salt water, and remain habitually in the depth of the sea. They never ascend rivers, nor do they generally approach the shores, except for the purpose of depositing their spawn.



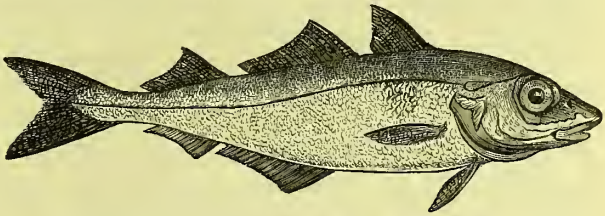
THE COD (*Gadus morrhua*).

The cod is very voracious; it feeds on small fish of all kinds, more especially on herrings and sprats, as well as on mollusca, worms, and crustacea. Mr. Couch has taken thirty-five crabs, none less than a half-crown piece, from the stomach of one cod. Its digestive powers are said to be very great, and under the influence of its gastric juice the shell of the crab or lobster grows red, just as it does when under the action of boiling water, and that even before the flesh is one quarter digested. The stomach of the cod often affords a rich harvest to the naturalist.

In the Firth of Forth cod are taken all the year through, sometimes in tolerable numbers, from whence the Edinburgh market is supplied; they are in the best season in the month of February, and remain in excellent condition till the end of April. They begin to deposit their spawn in the months of May and June, when they frequently ascend the Firth as far as Alloa, and are taken on their return in the salmon nets in a very poor and lean condition. The spawn that is thus annually shed by one parent fish, it is said, can give birth to nine millions three hundred and eighty-four thousand young. The fry are observed in the month of August swimming about in company with sprats, whitebait, and herrings, from two to three inches in length, beautifully freckled with light-brown and yellow. The growth of the cod-fish is said to be remarkably rapid, though the degrees of its progression are not ascertained. From the month of July to the end of October the large cod are observed to be long and thin, particularly those that are captured on sandy banks or in shallow water, being then of very light colour, with the flesh soft, unwholesome, and insipid to the taste; the fish not having had time sufficient to recruit themselves after the fatigue of spawning. The best cod are found in deep and rocky situations in the neighbourhood of the Isle of May and all around the mouth of the Firth. The dark variety of cod, generally known by the name of Rock, or Red Cod, is considered as the firmest and sweetest fish. It is found in very deep water, and feeds almost entirely on young lobsters and star-fish.

Cod are observed to thrive better while under confinement than most of the species of the same family, and, in some instances, they are found improved by the change. Elias Cathcart, Esq., of St. Margaret's, near North Queensferry, has kept for some time a number of marine fishes in a salt-water pond, of about 200 feet in length and five fathoms deep, in which the tide flows and ebbs twice in the day. The principal fishes preserved are cod, haddock, whiting, flounders, and skate, which are retained prisoners by means of an iron grating placed at that part of the pond which communicates with the Firth. They are fed by the keeper with sprats, young herrings, and other small fishes, besides occasionally with the intestines of sheep, which the cod are observed to devour with avidity. All the fish appear to thrive very well, especially the cod, which are found to be firmer in the flesh and thicker across the shoulders than those obtained from the Firth of Forth.

The cod, when in season, is white, firm, and of most excellent flavour. Its flesh is capable of being preserved in a state fit for eating much longer than that of most other species of this class. "Almost all parts of the cod are adapted for the nourishment of man and animals, or for some other purposes of domestic economy. The tongue, for instance, whether fresh or salted, is a great delicacy; the gills are carefully preserved, to be employed as baits in fishing; the liver, which is large and good for eating, also furnishes an enormous quantity of oil, which is an excellent substitute for that of the whale, and applicable to all the same purposes; the swimming bladder furnishes an isinglass not far inferior to that yielded by the sturgeon. The Iceland fishermen prepare large quantities of it, which in England sells for a high price. The head, in the places where the cod is taken, supplies the fishermen and their families with food. The Norwegians give it with marine plants to their cows, for the purpose of producing a greater proportion of milk. The vertebræ, the ribs, and the bones in general, are given to their cattle by the Icelanders. The lenses are made into necklaces for children, and the ear-bones are often found in the possession of the curious. Even their intestines and their eggs contribute to the luxury of the table." Its fishing is consequently of great importance, as affording subsistence and occupation to a numerous population.


THE HADDOCK (*Gadus æglefinus*).

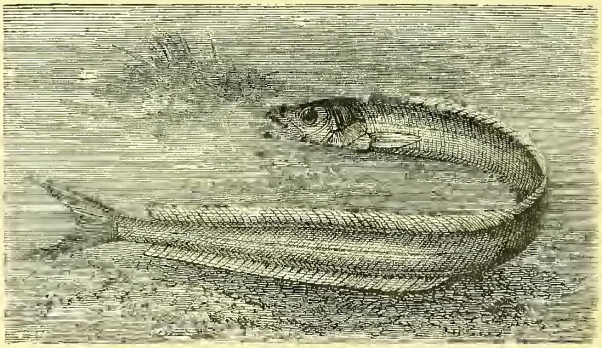
The Haddock (*G. æglefinus*), the Whiting (*G. merlangus*), the Pollack (*G. pollachius*), are also fishes of immense value, which want of space forbids us to do more than allude to. The Hake (*Merlucius vulgaris*) has an extensive range over the northern seas. It is a voracious fish, and its flesh is somewhat coarse, though it is dried and exported by us in great quantities to such fish-eating countries as Spain. The Ling (*Lota molva*) is scarcely less valuable than the cod. In the time of Edward III. it was regarded as so valuable an article of commerce, that there was an Act for regulating its price. Its air-bladders, under the name of *sounds*, are often separately prepared and sold with those of the cod. A good oil for burning is extracted from its liver.

The only British fresh-water fish of this order is the Burbot (*L. vulgaris*). It is found in North Europe to Siberia, and even in some parts of British India. In England it is to be met with in the Cam, in the Trent, in the Ouse, and a few other rivers. The Rock-ling (*Motella vulgaris*), the Great Forked Hake (*Phycis furcatus*), the Tadpole Hake (*Raniceps fuscus*), can only be enumerated. But we must find space for a brief allusion to, perhaps, the most voracious fish of the family, the Chiasmodon niger of Johnson. Dr. A. Carte writes:—"In the month of August, 1865, I received from Commodore Sir Leopold McClintock, R.N., a specimen of a fish which had been taken near the island of Dominica, about which he writes:—'Dr. Imray, Dominica, has given me a specimen, of which the two sketches enclosed may afford you some idea. A small fish with teeth inclined backwards swallowed a much larger one, and whilst helplessly floating was picked up and given to Dr. Imray. The swallowed fish was dead, the swallower still alive; the abdominal integument of the latter has been stretched enormously, and is as thin and transparent as goldbeaters' leaf, but quite perfect. Both fishes are known out here; but the smaller one is much the more rare." Total length of specimen from snout to extremity of tail, 6⅝ inches, the length of the enclosed fish (Scopelus macrolepidotus ?) 10½ inches.

"'The process of deglutition in all these fishes is evidently very simple. The fish, after having seized its victim with its sufficiently capacious and very movable jaws, partly presses it down, as a snake would do, partly draws itself over it. The prey is received into an œsophagus and stomach, the membranes of which are, like the external integument, extensible as an indiarubber pouch, and which therefore may contain a body twice or thrice the size of the destroyer. Organs externally attached to the integument, like the ventral fins, are naturally displaced. I have seen the empty stomach of Chiasmodus, in the specimen obtained by Mr. Lowe; it was contracted, folded up, and but little projecting downwards from the belly.'"

The family OPHIDIDÆ contains some fifty species, to be found from Greenland to New Zealand. The Bearded Ophidium (*O. barbatum*), Drummond's Fierasfer (*Fierasfer dentatus*), the Sand-eel (*Ammodytes tobianus*), and the Sand-lance (*A. lancea*), are the only British species.

Passing by the families MACRIORIDÆ and ATELEOPODIDÆ, we come to the FLAT FISHES, OR PLEURONECTIDÆ. These are marine carnivorous fishes, with strongly compressed flat bodies, one side colourless, and the eyes in the adults placed both on the coloured side. They love the sandy bottoms of comparatively shallow seas, and will often make their way a considerable distance up rivers. There are nearly two hundred species known, of which about twenty are British. Of these we will mention the best known.


THE SAND EEL (*Ammodytes tobianus*).

The Plaice (*Platessa vulgaris*) is described and figured by Rondelet, and was known to older naturalists long before his time. It inhabits sandy banks and muddy grounds in the sea, and among the Orkney Islands is caught by lines and hooks; but as it is not of large size there, it is not much sought after. It is common, however, in the Edinburgh market, where the small ones are called fleuks. On the English coast the plaice is obtained in abundance generally wherever either lines or trawl-nets can be used; and in Ireland this fish is taken from the county of Cork, round Cape Clear, along the whole Atlantic coast.

Plaice, called there, as elsewhere in Scotland, fleuks, abound on the sandy flats of the Solway Firth, and are taken by the fishermen and their families wading in the shoal water with bare feet. When a fish is felt, it is pressed by the foot firmly against the bottom until it can be secured by the hand and transferred to the basket. Long practice gives the dexterity which renders this kind of fishing successful.

The plaice spawns in February or March, and is considered to be in the finest condition for the table at the end of May. Diamond plaice is a name attached to those which are caught at a particular fishing-station off the Sussex coast, which is called the Diamond Ground. They are remarkable for the purity of the brown colour and the brilliancy of the spots.

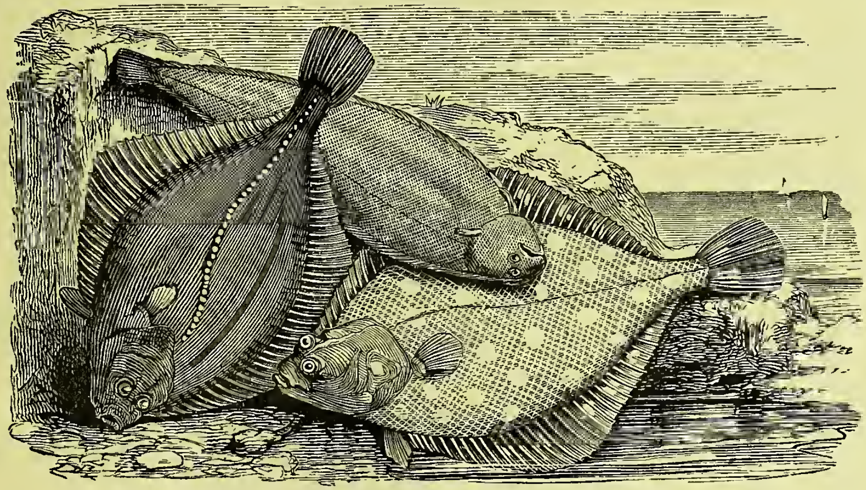
The plaice feeds on soft-bodied animals generally, young fish, and crustaceans, and has been known to attain the weight of fifteen pounds; but one of seven or eight pounds weight is considered to be a plaice of large size. It is taken sometimes in almost incredible numbers; and so great a glut occurred once in Billingsgate Market, that, although crowded with dealers, hundreds of bushels of plaice remained unsold. Great quantities of the fish, averaging three pounds weight each, were sold at a penny per dozen; and one salesman, having in vain endeavoured to sell a hundred bushels at the rate of fifty fish for fourpence, left them with Mr. Goldham, the clerk of the market, requesting him to sell them for anything he could get. Unable to dispose of them otherwise, Mr. Goldham, by direction of the Lord Mayor, divided them among the poor.

In some parts of the north of Europe, where from the rocky nature of the soil the sea is remarkably transparent, plaice, and some other flat fish of large size, are taken by dropping down upon them, from a boat, a doubly-barbed sharp spear, heavily leaded to carry it with velocity to the bottom, with a line attached to it, by which the fish, when transfixed, is hauled up.

In East Friesland the plaice has been transferred to fresh-water ponds, wherein it thrives well.

The Flounder (*P. flesus*) seems to live and thrive equally well in the sea, in brackish, and in fresh water. In the Thames it is caught from Deptford to Richmond; and Colonel Montagu says they are found up the Avon to within three miles of Bath. The Common Dab (*P. limanda*) is common to all the sandy parts of our coasts.

The Holibut (*Hippoglossus vulgaris*) is one of the largest species of the family. It appears not to be found in the Baltic, but is common in the northern seas. A specimen taken off the Isle of Man weighed 320 lbs. The flesh is good for food, though dry and with little flavour. Mr. Lord tells us of an apparently closely-allied species, that "it is a giant amongst flat fishes. It is taken by the Indians on the western side of Vancouver Island; a veritable ground-feeder, frequenting deep-sea sandbanks, and devouring anything and everything that comes within reach of its terrible mouth. The holibut at Vancouver Island attains to an immense size, 300 lbs. being no unfrequent weight. The Indians are most skilful in securing this leviathan of the deep, as I had an opportunity of seeing, when visiting the northern end of the island. Picture to yourselves an Indian village, built on a plateau overlooking an open roadstead; a crowd of Indians on the shingly beach, watching the departure of a large canoe, manned by four savages, awaiting my arrival.



THE FLOUNDER (*Platessa flesus*). THE PLAICE (*Platessa vulgaris*).

"We are off, and, swiftly crossing the harbour, the beach grows indistinct in the distance; but we still see the dusky forms of the Indians, the rough gaudily-painted huts, the gleam of many lodge-fires, and wreaths of white smoke slowly ascending through the still air; the square, substantial pickets shutting in the trade-fort, its roof and chimneys just peeping above, backed by the sombre green of the pine-trees, altogether presented a picture novel and pretty in all its details. The line at the bow is uncoiled, a heavy stone enclosed in a net attached as a sinker, a large hook made of bone and hard wood, baited with a piece of the octopus (a species of cuttle-fish), is made fast to the long line by a piece of hemp-cord, then comes a heavy plunge of the sinker, the rattle of the line as it runs over the side of the canoe, and we wait in silence for the expected bite.

"A tug, that came unpleasantly near to upsetting all hands, let us know that a holibut was bolting the tempting morsel, hook and all. A few minutes gave him time fairly to swallow it, and now a sudden twick buries the hook deeply in the fleshy throat; the huge flat fish finds, to his cost, that his dinner is likely seriously to disagree with him, whilst in the canoe all hands are in full employ. The bowman, kneeling, holds on tightly with both hands to the line; the savage next him takes one of the long spears, and quickly places on the end of it a shorter one, baited and bladdered; the other two paddle warily.

"At first the hooked fish was sulky, and remained obstinately at the bottom, until continued jerks at the line ruffled his temper, and excited his curiosity sufficiently to induce a sudden ascent to the surface; perhaps to have a peep at his persecutors. Awaiting his appearance stood the spearman, and, when the canoe was sufficiently near, in he sent the spear, plucking the long haft or handle from the shorter barbed spear, which remained in the fish, the bladder, floating like a life-buoy, marking the fish's whereabouts. The holibut, finding his reception anything but agreeable, tries to descend again into the lower regions—a performance now difficult to accomplish, as the bladder is a serious obstacle. Soon re-appearing on the surface, another spear was sent into him, and so on, until he was compelled to remain floating. During all this time the paddlers, aided by the line-man, followed all the twistings and windings of the fish, as a greyhound courses a doubling hare.

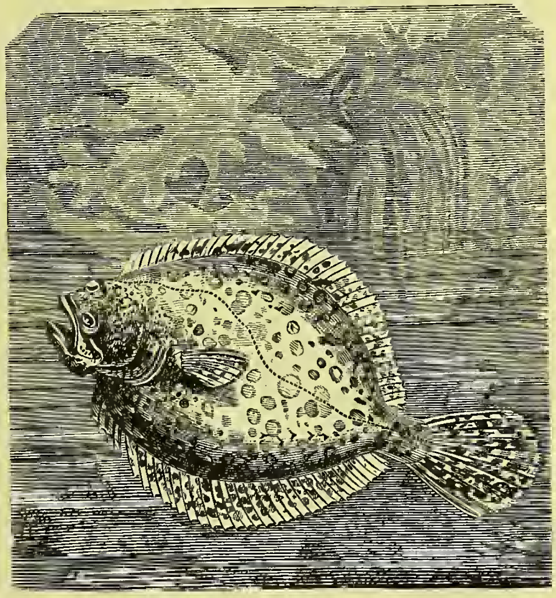
FISHING FOR HOLIBUT.

"For some time the contest was a very equal one, after the huge fish was buoyed and prevented from diving. On the one side, the holibut made desperate efforts to escape by swimming; and on the other, the Indians, keeping a tight line, made him tow the canoe. Evident signs of weariness at last began to exhibit themselves; his swimming became slower, and the attempts to escape more feeble and less frequent. Several times the canoe came close up to him, but a desperate struggle enabled him once more to get away. Again and again we were all but over; the fish, literally flying through the water, sometimes towed the canoe nearly under, and at others spun it suddenly round, like a whipped top; nothing but the wonderful dexterity of the paddlers saved us from instant shipwreck and the certainty of drowning. I would have given much to have stood up; but no; if I only moved on one side to peep over, a sudden yell from the steersman, accompanied by a flourish of the braining-club—mildly admonitory, no doubt, but vastly significant—insured instant obedience. I forgot cold, wet, and fright, and indeed everything but the all-absorbing excitement attendant on this ocean-chase. The skill and tact of the uneducated men, pitted against a huge sea-monster of tenfold strength, was a sight a lover of sport would travel any distance to witness.

"Slowly and steadily the sturdy paddlers worked towards the shore, towing the fish, but keeping the canoe stern first, so as to be enabled to pay out line and follow him, should he suddenly grow restive. In this way the Indians gradually coaxed the flat monster towards the beach; a weak, powerless, exhausted giant, outwitted, captured, and subdued, prevented from diving into his deep-sea realms by, what were to him, anything but life-buoys. We beached him at last, and he yielded his life to the knife and club of the redskins."

The Turbot (*Rhombus maximus*) is of a short and broad form, and rather deeper than many of the flat fishes. Its prevailing colour is brown, and the whole of the coloured side is studded with hard and roundish tubercles.

The turbot is most active in the night-time, when, perhaps, its enemies are less vigilant; and in the day-time it lies at the bottom, with its dark side uppermost, and is consequently difficult to be distinguished. It is said that, when apprehensive of danger, it will remain perfectly still. Man is, probably, its most active enemy. Great care is necessary in having a suitable bait; for, though voracious, the turbot is delicate in its choice of food. A piece of herring or haddock is commonly used for a bait, but if it has been twelve hours out of the water, though not tainted, the turbot will not take it. Many years ago, and it may still be the case, the Dutch purchased of the Thames fishermen the lesser lamprey, for bait, to the value of £700 a year. The Scarborough fishermen were accustomed to obtain a supply by land carriage from the river Wharfe, a distance of about sixty miles.


THE TURBOT (*Rhombus maximus*).

The fishery is carried forwards on the north-eastern coast. Each person is provided with three lines, which are fairly coiled upon a flat, oblong piece of wicker-work, the hooks being baited, and placed very regularly in the centre of the coil. Each line is furnished with fourteen score of hooks, at the distance of six feet two inches from each other. The hooks are fastened to the lines upon "steads" of twisted horse-hair, twenty-seven inches in length.

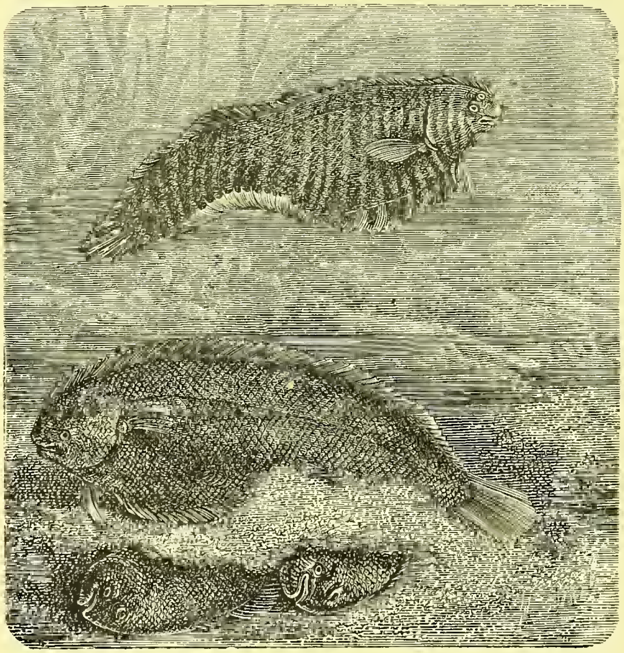
When fishing, there are always three men in each cable, and consequently nine of these lines are fastened together, and used as one line, extending in length nearly three miles, and furnished with two thousand five hundred and twenty hooks. An anchor and a buoy are fixed at the first end of the line, and one more of each at the end of each man's lines; in all, four anchors, which are commonly perforated stones, and four buoys, made of leather or cork. The line is always laid across the current, and remains on the ground about six hours, as it can only be shot or hauled at the turn of the tide. The rapidity of the tide on this coast prevents the use of hand-lines, and therefore two of the men commonly wrap themselves in a sail and sleep, while the other keeps a sharp look-out, to observe the weather, and from fear of being run down by ships.

The coble is about one ton in burden, rather more than twenty feet long, extreme breadth five feet, and it is rowed with three pairs of oars. A larger description of boat is also used in the Scarborough turbot fishery. It is forty feet long, fifteen broad, and of twenty-five tons burden, and is called the "five men boat," though usually navigated by six men and a boy; but one of the men is hired to cook, and does not share in the profits with the other five. Two cobles are taken on board, and when they reach the fishing ground they anchor, and proceed to fish in the cobles, and being provided with a double set of lines, they haul one and shoot another every turn of the tide. They generally run into harbour twice a week, to deliver their fish. Similar means are employed along our southern coasts, but the London market is chiefly supplied by the Dutch fishermen.

The fishing season commences in March, and terminates in August. The Dutch are supposed to have drawn not less than £80,000 a year, for the supply of this fish to the London market alone. The English fishermen purchase at sea largely of the Dutch; nevertheless, the Dutch send boats laden with turbot up the Thames, each boat bringing about one hundred and fifty fish. The Danes also are said to derive from £12,000 to £15,000 a year for sauce to this luxury of the table, extracted from a million of lobsters, taken on the rocky shores of Norway, though our own shores are in many parts plentifully supplied with this creature, equal in goodness to those of Norway. The finest turbot are taken on the Flemish banks, and the banks called Broad Forties. Excellent fish are also taken by the French fishermen, on the two large sand-banks called the Varne and the Ridge, stretching towards the French coast in the Channel, not many miles from Dover. These they sell to the English out at sea, or send into Dover.

The average size of a turbot is from three to ten pounds weight; but some of huge size have been occasionally taken, which have weighed from fifty to seventy pounds; and one was caught in 1832, near Whitby, which weighed one hundred and ninety pounds.

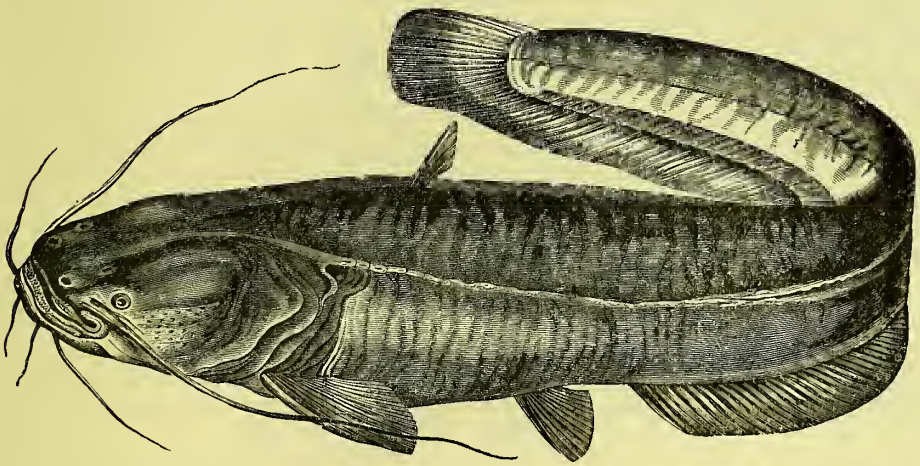
The Brill (*Rhombus vulgaris*) is very similar to the turbot in appearance, but inferior in flavour. It is taken with lines and hooks, the bait being mussels, cockles, sand-worms, and herrings, cut in pieces. It is common in the markets, and may at once be distinguished from the turbot by its less broad form, the want of the osseous tubercles on the coloured side of the body, and the colouring, which is reddish or sandy-brown, varied with darker brown, and minutely spotted with white. This fish is the Bonnet Fleuk of the Scotch. It often attains an enormous size, is abundant on our southern coasts, and all the localities where the turbot occurs. It inhabits deep water and sandy bays.


THE SOLE (*Solea vulgaris*).

The Sole (*Solea vulgaris*) is one of our most valuable fishes, and is found around the shores of our island, and along those of the adjacent continent. It exists in the Baltic, and also in the Mediterranean. It usually tenants beds of sand, where it feeds on shelly molluscs. The sole is taken by the trawl-net, and there are numerous fishing stations along our coast, especially off Sussex and Devonshire, where vast numbers are captured, the supply appearing inexhaustible. The sole is in season all the year round, excepting during the latter part of February, when its flesh becomes flabby. In a few weeks, however, it recovers, and continues in excellent condition. Mr. Yarrell states that in the course of one twelvemonth eighty-six thousand bushels of soles were received at Billingsgate Market. Occasionally, this fish is to be seen of large size, weighing eight or ten pounds the pair; and there is an account of one given by Mr. Yarrell which was twenty-six inches long, eleven inches and a half wide, and weighed nine pounds.

ORDER IV.—PHYSOSTOMI.

This is the largest of all the orders, containing at present over 2,600 species, and to treat of them as we would like, they would require a whole volume to themselves. They are usually furnished with a complete series of fins, which are composed entirely of soft rays, with the exception of the first ray of the dorsal, anal, and pectoral fins, which are sometimes spiny. There is never more than one rayed dorsal fin, but occasionally there is a second fat (*adipose*) fin behind this one. The air-bladder is always connected with the back of the pharynx by means of a tube (*duct*). In some the ventral fins are wanting (*Apoda*); in others they are placed on the abdomen (*Abdominalia*). Dr. Günther makes thirty families; the first is that of the Siluroids, or Siluridæ. These are fresh-water, or marine fishes, often scaleless, but covered here and there with ganoid (bony) plates, and the head always furnished with tags (barbels). They are to be found in the fresh waters of all the temperate and tropical regions, and those entering the sea keep near the coast. But one species is European; this is the Silurus (*Silurus glanis*), the largest of European fresh-water fishes. It occurs, though but rarely, in the Scandinavian rivers and lakes, but is common in the Danube and its affluents. It has not been found in Ireland or England, nor in France, Spain, or Italy. It is named saluth by the Swiss; wels and schaiden, or schade, by the Germans: the latter name being probably the origin of sheat, or having the same derivation. In Prussia it is a common fish, and also in Poland, being most abundant in Styria. One, sixteen feet long, was taken in the Bug.



THE SHEAT FISH (*Silurus glanis*).

"The silurus of Europe is depressed at the head, rounded at the shoulders, and compressed posteriorly. Its dorsal profile is nearly straight. The mouth occupies the whole breadth of the head, and on both jaws there is a broad band of crowded card-like or coarsely villiform teeth; on the front of the vomer there is a second band parallel to the front one, the rest of the palate being smooth, as well as the tongue, which is merely a flat eminence on the floor of the mouth. The maxillary, lying a little before a membranous fold at the corner of the mouth, has a very short bony stem, but is prolonged into a compressed barbel, which reaches backwards to the pectoral fin. There are, moreover, four barbels on the mandible. The gill-opening commences in the middle of the height of the trunk of the fish, and curves downwards to the throat between the limbs of the mandible. The pectoral is attached low down, and has a very stout spine for a first ray, near whose point there are some fine denticulations internally. The first ray of the ventral is simple, but not spinous. All the rays of the very small dorsal are soft and branched. The vent is a small round hole behind the ventrals; and behind it again there is a fleshy tubercle, with the orifice of an efferent tube in its point. The anal joins the caudal; its rays are all soft and branched.

"The skin is soft and smooth throughout, without scales. The lateral line is a continuous and nearly straight series of very slender, slightly-elevated lines. The general colour is a brownish-olive, with deeper and lighter shades." M. Valenciennes gives the internal anatomy and the curious osteology in much detail, which the reader is recommended to study in the original. The silurus attains a greater size than any other European fresh-water fish. It is very voracious, and the author we quote from gives some remarkable instances of its shark-like propensities. In the year 1700, on the 3rd of July, a countryman took one near Thorn, which had the entire body of an infant in its stomach; and Grossinger relates that a Hungarian fisherman found the corpse of a woman in another, having a marriage ring on her finger and a purse full of money at her girdle!

As another example of this remarkable family, we extract the following from a paper by Professor Wilson on the Malapterurus beninensis:—"We are indebted to the zealous and intelligent missionaries of the United Presbyterian Church of Scotland, resident at different stations on the River Old Calabar, for our knowledge of the new species of electric fish. Quite recently they have sent home living specimens, some of which are now in Edinburgh; and through the kindness of Professor Goodsir and Mr. Murray, I, along with others interested in the electric energies of the animal, have had the opportunity of observing their shock-giving powers. The shock is a sharp one, felt from the fingers to the wrist, the elbow, or the shoulder, according to the activity of the animal and the position in regard to it of the hands of the experimenter. The fish varies in length from two to twelve inches, is sluggish in its general movements, but retentive of vitality and electrical energy, even in unfavourable circumstances.

"As soon as my attention was turned to the remedial employment of electric fishes, I proceeded to inquire whether the Africans along the Old Calabar River made any therapeutic use of its malapterurus. But before my inquiries were completed, I learned that the natives did make this use of the fish. In truth, the fact had been published by Mr. Murray two years ago, but I had overlooked the circumstance. The statement, which is quoted below, is the more interesting that it was not furnished in reply to queries, but was volunteered by Mr. W. C. Thomson, who was stationed for several years at the Creek Town Mission-station on the Old Calabar River. Mr. Murray says:—'Mr. Thomson tells me that the electric properties of the fish are made use of by the natives as a cure for their sick children. The fish is put into a dish containing water, and the child made to play with it; or the child is put in a tub or other vessel with water, and one or more of the fish put in beside it. It is interesting to find that a remedy which has only of recent years come into favour among ourselves should have been already anticipated by the unlettered savage, who probably has had the remedy handed down to him by tradition from remote generations.'

"Unaware of this very precise announcement and inference, I applied to the Rev. W. Anderson, who brought from Old Calabar the living fishes at present in Edinburgh, and received the following answer:—

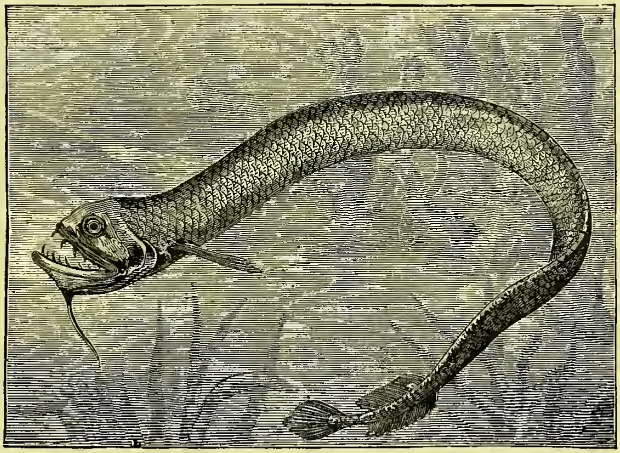
"'In reply to your query, I have to state that I am not aware of any statement having been published in reference to the remedial properties of a shock from the fishes, neither have I seen them used in any way in sport; but Mrs. Anderson, to whom belongs all the credit of bringing the fishes home, testifies that the native mothers generally keep one of the fishes in a native-made basin, and that on washing their infants in the morning the practice is to dip either the hands or the feet of the infant, so as to cause it to receive a shock. This is done, they say, for the purpose of strengthening the child. The strong and the healthy have to undergo the operation as well as the weak and sickly. And that the fish is not an inactive agent in this singular process may be safely inferred from what follows. So far as Mrs. Anderson's observation goes, there is no liking for the affair on the child's part; plenty of struggling and squalling. The natives use the fish as food.'

"A third and independent account of the native usages in reference to the malapterurus has been kindly furnished to me by the Rev. Dr. Somerville, who obtained it from Mr. John R. Wylie, recently a teacher at Creek Town, Old Calabar, but at present in Edinburgh on sick leave. Mr. Wylie says:—'The Calabar women use this fish in the following manner: They put one or two, according to the size, in a tub of water, and then wash their children (infants) in the tub with the fish and all. They must have a strong sense of the benefit derived from this, as in general they dislike doing anything which makes their infants cry; and this process makes them do so most lustily. They also make the children drink a quantity of the water in which these fish have been. I have been in yards, and seen, on several occasions, the process described.'

"The description of remedial virtues to the water in which the malapterurus has been kept is a fact of interest, when taken in connection with the similar opinion entertained by the Greeks, according to Ælian, in reference to the water in which a torpedo had lain."

Space compels us to say nothing of the egg-carrying propensities of Arius fissus; of the nest-building of some species of Callicthys, of such brilliantly-coloured forms as the Dawalla of the Arawaaks (*Hypophthalmus dawalla*); of the great Lau lau, next but one the largest fresh-water fish of the rivers of Guiana, that can run away with a canoe and its owner. Probably no family of fish contains so many strange, weird forms as this; and few seem more to link the present fish-forms with the past. We believe that a species of Trichomycterus has the "highest" living-place of any fish on the globe, being found up to an elevation of 15,000 feet in South America.

The family CHARACINIDÆ contains over 235 species, all fresh-water fish, without any barbels. They have usually, like the carp and salmon, an adipose fin. They are found in the rivers and lakes of tropical countries, where they often attain a large size. Dr. Günther makes forty-eight genera. The fish of this family seem to abound in the warm waters of South America. Schomburgk is enthusiastic about the delicious flesh of the Pacu of Guiana (*Myletes pacu*). He and his followers were always delighted when they reached the regions where it abounded. It is fond of feeding on ripe seeds and fruits. Another species (*Serrasalmo niger*) is among the most voracious of fish, and is dreaded by every one living on the banks of the rivers where it abounds. The jaws of the fish are so strong that they are able to bite off a man's finger or toe. They attack fish of ten times their own weight, and devour all but their heads. They begin at their caudal fin. With all this, their flesh is pure white, and well tasted.



THE BOA FISH (*Stomias boa*).

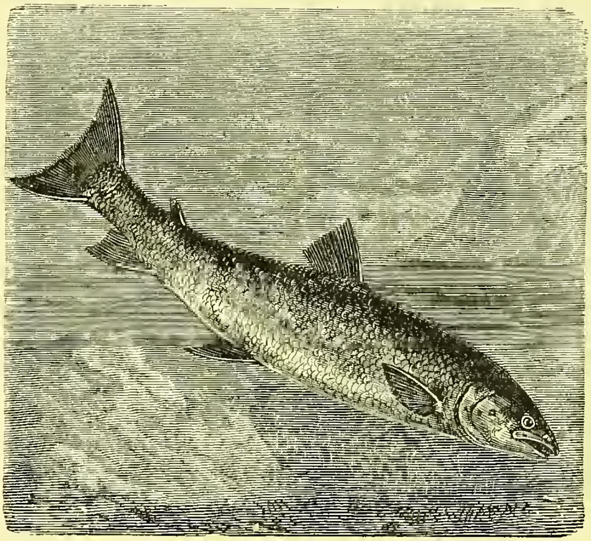
The family of STERNOPTYCHIDÆ contains a few marine fishes, to be met with in the deeper parts of the Atlantic and the Mediterranean, and very remarkable for having rows of phosphorescent organs all along the under surface of their bodies. One species (*Maurolicus borealis*) has a regular series of luminous spots on each side of its body. Other families of deep-sea fish that come in are SCOPELIDÆ, with such rare species as SCOPELUS HUMBOLDTII and STOMIATIDÆ, with that strange and rare form Stomias boa.

The SALMONS, OR SALMONIDÆ, are a pretty numerous family, chiefly fresh-water, but many of the species periodically descend to the sea. They are chiefly confined to the northern regions of both the hemispheres, though a species is found native in New Zealand. The genus Salmo is supposed to contain by some over 120 species. Dr. Günther recognises about 90.

The Salmon (*Salmo salar*), says Izaak Walton, "is the king of fresh-water fish," and, he adds quaintly, "he has, like some persons of honour and riches, which have both their winter and summer residences, the fresh rivers for summer, and the salt water for winter to spend his life in."

This fish is a periodical visitor to our rivers, in which it breeds, depositing its eggs in the gravel in the winter, having pushed up from the estuary during the autumn, to which it again descends in the spring, and passes the latter part of the summer in the sea. It appears, however, that the breeding season of this fish, and consequently, the precise time of its visit to the upper portions of the rivers, are influenced by various causes, which hasten or retard the development of the roe. "There are two rivers," says Sir William Jardine, "in Sutherlandshire, which show this late and early running (of the salmon) under peculiar circumstances. One, the Oikel, borders the county, and springs from a small Alpine lake, perhaps about half a mile in breadth; the other, the Shin, is a tributary to the Oikel, joins it about five miles from the mouth, but takes its rise from Loch Shin, a large and deep extent of water, and connected to a chain of other deep lochs. Early in the spring, all the salmon entering the common mouth diverge at the junction, turn up the Shin, and return, as it were, to their own and warmer stream, while a very few keep the main course of the Oikel until a much later period."

The vigour displayed by the salmon in shooting up the most impetuous rapids is very wonderful, nor do waterfalls or cascades daunt them. Curving the body till the tail and head meet, they give a lash with all their force to the water, and spring up with amazing address. Often they miss their leap, and fall back into the river, but it is only to wait for fresh strength, and more energetically to renew their attempt; thus they surmount a fall of eight or ten feet, but not always without accidents. Sometimes they throw themselves out of the stream upon the rocks and stones, and so perish; and sometimes they kill themselves, by the repetition of their fruitless efforts.


THE SALMON (*Salmo salar*).

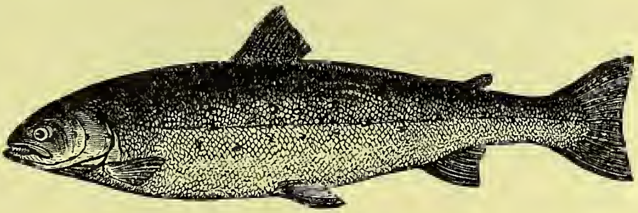
Having at length arrived at their proper breeding places, shallow gravelly pools in the pure stream, the salmon prepare for the deposition of the eggs. At this time the cheeks of the male become variegated with stripes of orange colour, and an orange tinge pervades the body; the lower jaw becomes elongated at its tip, by the development of a cartilaginous projection, which, when the mouth is closed, occupies a deep notch at the end of the snout. The female at the same time assumes a dark colour, and both are respectively called red and black fish. Each pair now begins to make a furrow in the gravel, working with their snouts against the stream. When this is finished, the female deposits a number of her eggs in it, and covers them up. The pair then proceed to work out other furrows, and in about ten or twelve days the whole of the eggs are deposited. Supposing the eggs to be deposited early in November, they are hatched in March, or early in April, and the young fry exhibit a rapid growth. After spawning, the salmon begin their descent to the estuary, and so enter the sea, to commence their re-ascent in autumn.

These migrations up the rivers take place earlier or later, in autumn or spring, according to the peculiarities of the river or the condition of the fish; and soon after breeding, the salmon again gradually descend to the sea; consequently, the spawning time varies, being earlier or later, according to circumstances. Rivers issuing from large lakes afford early salmon, the waters having been purified by deposition in the lakes, while, on the other hand, rivers swollen by melting snows in the spring months are later in the season of producing fish, and yield their supply when the lake rivers are beginning to fail.

The increasing scarcity and consequent high price of salmon has directed public attention during the last few years to the artificial propagation of fish, which has been practised with considerable success on the Continent, as well as in our own country. This art dates from the time of the Romans, among whom, however, it appears to have consisted rather in conveying the spawn of fish from the spawning-bed to an exhausted lake, and thus replenishing the waters, than actually ejecting the ova and impregnating them with milt by an artificial process. It is satisfactory, however, to know that the importance of the subject is now generally recognised; and that the production of cheap food by the propagation of different kinds of fish has become a valuable branch of industry.

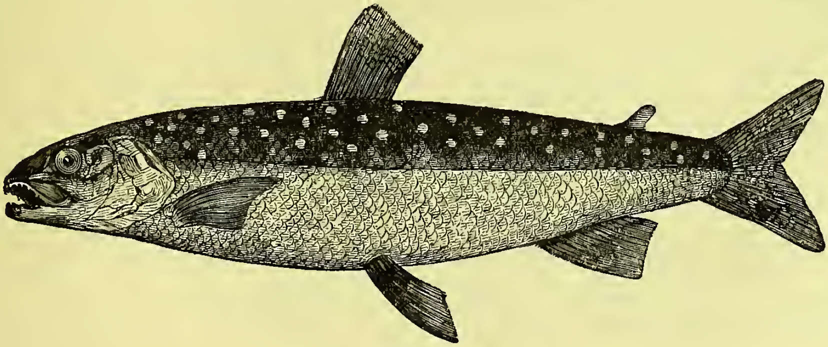
The Trout (*S. fario*) frequents most of the rivers and lakes of Europe, and is greatly prized by the angler. We can only mention the following as native—the Salmon Trout (*S. trutta*) and the Charr (*S. salvelinus*). All these fish have more or less of oil diffused through their flesh. The quantity of oil would seem to reach quite a maximum in the fish called the Candle-fish (*Mallotus pacificus*). Mr. Lord tells us:—

"There is a fish, small in size, not larger than a smelt, that is fat beyond any description, clad in glittering silver armour, and found on the coasts of British Columbia, Russian America, Queen Charlotte and Vancouver Islands, which is called by the natives Eulachon, or Candle-fish. I have had both leisure and opportunity to make this fish's intimate acquaintance, played the spy upon its habits, its coming and going, and have noted how it is caught and cured.


THE TROUT (*Salmo fario*).

"Picture my home—an Indian village on the north shore of British Columbia. The moon, near its full, creeps upward from behind the hills; stars one by one are lighted in the sky—not a cloud flecks the clear blue. The Indians are busy launching their canoes, preparing war against the candle-fish, which they catch when they come to the surface to sport in the moonlight. As the rising moon now clears the shadow of the hills, her rays slant down on the green sea, just rippled by the land-breeze. And now, like a vast sheet of pearly nacre, we may see the glittering shoals of the fish—the water seems alive with them. Out glides the dusky Indian fleet, the paddles stealthily plied by hands far too experienced to let a splash be heard. There is not a whisper, not a sound, but the measured rhythm of many paddlers, as the canoes are sent flying towards the fish.

"To catch them, the Indians use a monster comb, or rake, a piece of pine-wood from six to eight feet long, made round for about two feet of its length, at the place of the hand-grip; the rest is flat, thick at the back, but thinning to a sharp edge, into which are driven teeth about four inches long and an inch apart. These teeth are usually made of bone, but when the Indian fishers can get sharp-pointed iron nails, they prefer them. One Indian sits in the stern of each canoe to paddle it along, keeping close to the shoal of fish; another, having the rounded part of the rake firmly fixed in both hands, stands with his face to the bow of the canoe, the teeth pointing sternwards. He then sweeps it through the glittering mass of fish, using all his force, and brings it to the surface teeth upward, usually with a fish impaled, sometimes with three or four upon one tooth. The rake being brought into the canoe, a sharp rap on the back of it knocks the fish off, and then another sweep yields a similar catch.


THE CHARR (*Salmo salvelinus*).

"The sport over, we glide under the dark rocks, haul up the canoe, and lie before the log-fire to sleep long and soundly. The next labour is that of the squaws, who have to do the curing, drying, and oil-making. Seated in a circle, they are busy stringing the fish. They do not gut or in any way clean them, but simply pass long smooth sticks through their eyes, skewering on each stick as many as it will hold, and then lashing a smaller piece transversely across the ends, to prevent the fish from slipping off the skewer. This done, next follows the drying, which is generally achieved in the thick smoke at the top of the sheds, the sticks of fish being there hung up side by side. They soon dry, and acquire a flavour of wood-smoke, which helps also to preserve them. No salt is used by Indians in any of their systems of curing fish. When dry the candle-fish are carefully packed in large frails made from cedar-bark or rushes, much like those one buys for a penny at Billingsgate ; then they are stowed away on high stages made of poles, like a rough scaffolding. However hungry or however short of food an Indian family may be during summer-time, it seldom will break in on the winter 'cache.' I have never seen any fish half as fat and as good for Arctic winter-food as these little candle-fish. It is next to impossible to broil or fry them, for they melt completely into oil. Some idea of their marvellous fatness may be gleaned from the fact that the natives use them as lamps for lighting their lodges. The fish, when dried, has a piece of rush-pith, or a strip from the inner bark of the cypress-tree (*Thuja gigantea*), drawn through it, a long round needle made of hard wood being used for the purpose ; it is then lighted, and burns steadily until consumed. I have read comfortably by its light. The candlestick, literally a stick for the candle, consists of a bit of wood split at one end, with the fish inserted in the cleft.

"These ready-made sea-candles—little dips wanting only a wick that can be added in a minute—are easily transformed by heat and pressure into liquid. When the Indian drinks instead of burning them, he gets a fuel in the shape of oil that keeps up the combustion within him, and which is burned and consumed in the lungs just as it was by the wick, but only gives heat. As soon as the Indians have stored away the full supply of food for the winter, all the fish subsequently taken are converted into oil. A vast quantity of oil is thus obtained ; often as much as seven hundredweight will be made by one tribe. Not only has Nature, ever bountiful, sent an abundance of oil to the redskin, but she actually provides ready-made bottles to store it away in. The great seawrack, that grows to an immense size in these northern seas, and forms submarine forests, has a hollow stalk, expanded into a complete flask at the root end. Cut into lengths of about three feet, these hollow stalks, with the bulb at the end, are collected and kept wet until required for use. As the oil is obtained, it is stored away in these natural quart bottles, or rather larger bottles, for some of them hold three pints.

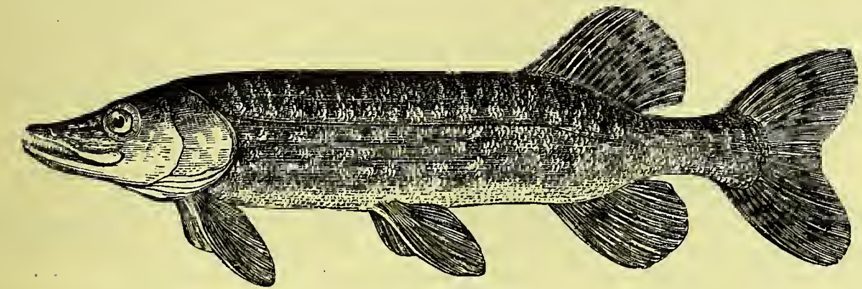
"Some fifty years ago, vast shoals of eulachon used regularly to enter the Columbia ; but the silent stroke of the Indian paddle has now given place to the splashing wheels of great steamers, and the Indian and the candle-fish have vanished together. From the same causes the eulachon has also disappeared from Puget's Sound, and is now seldom caught south of latitude 50° N."

The Grayling (*Thymallus vulgaris*) is a native of some of the English rivers, and the Smelt (*Osmerus eperlanus*) is a small silvery fish, to be met with on the east and west coasts of Great Britain, but is apparently not met with in Ireland. The Medway smelts are famous. The smelt ascends rivers between August and May to spawn. They were at one time common in the Thames up to the Hammersmith Bridge. Their strong cucumber-like smell is well known.

The families MORMYRIDÆ and GYMNARCHIDÆ contain fresh-water fishes peculiar to the Nile, and to a few other African rivers.

The ESOCIDÆ are also fresh-water fish, with scaly bodies, and with their dorsal fins situated down towards their tails. One well-known species, the Pike (*Esox lucius*), ranges in Europe from Lapland to Turkey, and in the New World from the Arctic regions to Albany river. It is said by some to have been introduced into Great Britain and Ireland.

The voracity of the pike is connected with its rapidity of growth, which necessitates an abundant supply of nutriment. Eight pike, of about five pounds each, have been ascertained to devour eight hundred gudgeons in three weeks. Some idea from this may be formed of the havoc this fish must make in the meres, lakes, or rivers, in which it is plentiful, and of the necessity of encouraging the breeds of inferior fishes, as the bream and others, for its maintenance. The pike not only lives to an extreme age, but attains to extraordinary dimensions. Pennant speaks of one ninety years of age ; and Gesner notices a pike taken at Heilbroon, in Suabia, in 1497, with a brazen ring attached to it, on which was inscribed, in Greek characters, " I am the fish which was first of all put into the lake by the hands of the governor of the universe, Frederick the Second, the 5th of October, 1230." This fish must, therefore, have been at least two hundred and sixty-seven years old. It is said to have weighed three hundred and fifty pounds.

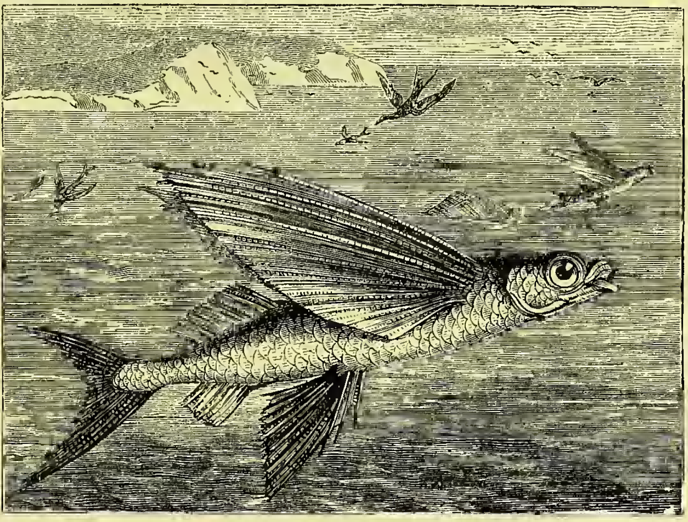


THE PIKE (*Esox lucius.*)

In the lakes of Scotland and Ireland, pike weighing from fifty to seventy pounds have occasionally been taken ; and Horsea Mere and Heigham Sounds, two large sheets of water in Norfolk, have been long celebrated for the size and excellence of their pike, and also for their abundance.

The Scomberesocidæ are by many placed near the Labridæ. They are marine or fresh-water fishes, with scaly bodies, and with a row of keeled scales on their sides. The Sea Pike (*Belone vulgaris*) is common around our coasts, where it receives a large number of local names, such as Garfish, Mackerel Guide, &c. Its skeleton is green before and after boiling. The long bill-like jaws are often of unequal length. But the most singular fishes belonging to this order are the Flying-fishes. The genus Exocetus contains over forty kinds, and nearly all are inhabitants of the tropical seas. Some extend as far north as the Mediterranean, and south as far as Australia.

The Common Flying-fish (*E. volitans*) has even occasionally been seen in the English Channel. Their pectoral fins are very large, enabling them to float through the air. "I have never," says Mr. George Bennett, " been able to see any percussion of the wings during flight, and the greatest length of time that I have seen this volatile fish on the fin has been thirty seconds by the watch, and their longest flight, mentioned by Captain Hall, has been two hundred yards ; but he thinks that subsequent observation has extended the space. The most usual height of flight, as seen above the surface of the water, is from two to three feet ; but I have known them come on board at a height of fourteen feet and upwards ; and they have been well ascertained to come into the channels of a line-of-battle ship, which is considered as high as twenty feet and upwards. But it must not be supposed



THE FLYING FISH (*Exocetus volitans*).

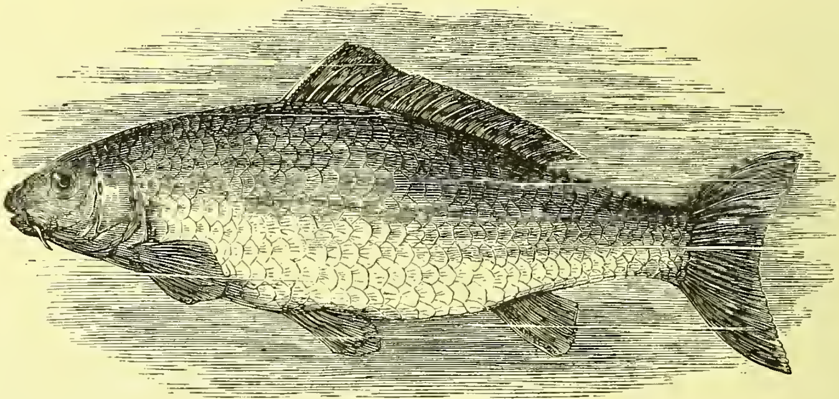
they have the power of elevating themselves in the air after having left their native element; for, on watching them, I have often seen them fall much below the elevation at which they first rose from the water, but never, in any one instance, could I observe them rise from the height at which they first sprang; for I regard the elevation they take to depend on the power of the first spring or leap they make on leaving their native element."

The CYPRINODONTIDÆ form a family of fresh-water fish, with over a hundred species. Many of them are found in Southern Europe, Asia, and Africa, and a great many in tropical America. Many of the species have a very limited area of distribution; thus all the species of Oresteas are confined to Lake Titicaca, and one lovely little species (*Haplochilus playfairii*) is only to be found in a little stream in one the Seychelles.

The HETEROPYGII form a family with two genera and two species, both found in America. One is the famous Blind-fish (*Amblyopsis spelæus*) of the great Kentucky caverns; the other differs from it in little except in having eyes, and is found in ditches in South Carolina.

The CARP, OR CYPRINIDÆ, form the largest family in this sub-order, containing over eight hundred species. They are all fresh-water fish. Unlike the salmon, they have no adipose fin, and their mouth wants teeth, though these are present about the throat.

Here we could not even enumerate the hundred and ten genera, but as types of the family we select the Carp (*Cyprinus carpio*). The usual size which this fish attains in English rivers is from twelve to fifteen or sixteen inches. Walton had never seen one exceeding twenty-three inches in length, but knew that they were found of a larger size. No fish can be so easily conveyed from place to place. So tenacious is it of life, that in Holland it is often kept for three weeks or a month suspended in a net with wet moss, and fed with bread steeped in milk, care being taken to refresh the fish now and then by pouring water on the moss.



THE CARP (*Cyprinus carpio*).

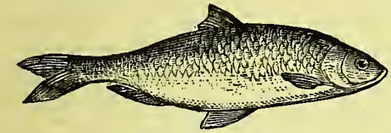
The haunts of the carp in summer are in deep holes, under roots of trees and hollows of banks, or amidst weeds or flags. In winter they bury themselves in the mud in the quietest parts of the river. The spawning time is at the end of May or the beginning of June. In the roe of a female weighing six pounds the number of ova was 600,000; and in another, weighing ten pounds, there were 700,000.

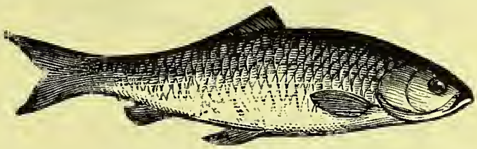
The Goldfish (*C. auratus*) is the pretty species kept in glass bowls in rooms. It was introduced into this country about the end of the seventeenth century from China, where they are kept in houses in a similar manner. Their radiant hues, and lively, graceful movements, are peculiarly pleasing to the eye. When young, they are of a dark and almost black colour, the golden red hue appearing as they become older. They abound in many of the streams in Portugal, from whence they are brought for sale to England, where they have become naturalised, and often breed in ponds which are warm and sheltered, especially in those where the temperature is raised by the discharge of warm water from steam-engines.

The Barbel (*Barbus vulgaris*) sometimes measures three feet in length, and weighs from fifteen to eighteen pounds. It is gregarious in its habits, and is swift and vigorous. During the summer these fish frequent the shallow parts of the river, and the female, in

May or June, deposits her eggs in the gravel. Though very shy, they are said to be extremely sportive, darting with the utmost ease up the most rapid current. Worms, the larvæ of insects, and small fishes, are their ordinary food; and they love to lurk among weeds, digging in the mud with their noses, probably in quest of prey. On the approach of winter they seek the deeper parts of the river, and shelter themselves in holes under the bank, or the wood-work of locks, dams, or weirs, and similar situations. In severely cold weather they sink into a state of partial torpidity, and may be captured by means of a landing-net, without attempting to escape.

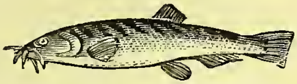
Of the genus Leuciscus we can only mention as native species the Roach (*L. rutilus*); the Dace (*L. vulgaris*); the Chub (*L. cephalus*); the Bleak (*L. alburnus*); the Rudd (*L. erythrophthalmus*); nor must we omit all notice of the Minnow (*Phoxinus lævis*) and the Loach (*Cobitis barbatula*).


THE ROACH (*Leuciscus rutilus*).


THE CHUB (*Leuciscus cephalus*).

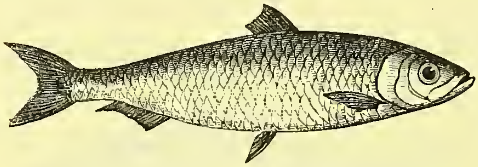
The family Osteoglossidæ contains some half-dozen fresh-water fish, with large, hard scales, of which the best known is the great Pirarucú of the Amazons (*Arapaima gigas*). The following is Schomburgk's spirited account of a hunt for this immense fish:—

"Partly to serve us for economical purposes, but more to satisfy our curiosity of witnessing the Indian manner of hunting the arapaima, this giant of the fresh-water fishes, Irai-i, the carib chieftain at Curassawaka, induced his men to afford us an opportunity. We selected a sunny day, when there was more chance that at the heat of noon-tide one of these fishes would rise to the surface. Our party was distributed in five small corials, and we proceeded towards the mouth of the small stream Curassawaka, where it enters the Rupunani. Here we remained stationary, one of the corials being put on the watch, and no length of time had elapsed when the signal was given that an arapaima was in sight. All hands were hushed as death. Irai-i and his brother-in-law, Dabaero, who were considered the strongest and best shots, went forward with their corial, and approached the fish as nearly as possible, the rest following softly to be within arrow-shot. There stood the sinewy carib, Dabaero, his foot firmly resting upon the bow of the corial, his left hand grasping the large bow of tough namara, his right the long arrow, upwards of six feet in length, and armed with a formidable iron point. His position, although forced to the unpractised, developed the symmetric forms of his figure, unadorned as it was by any art. Only those who have witnessed the Indian's eye, when the bow is strung, and he approaches his intended victim, can have any idea of that expression and that fire by which it appears lighted. Irai-i had adopted a similar position, when the crack of the bow-string told us that Dabaero had discharged his arrow, and the chief followed his example, but missed, his arrow floating on the water, while the other disappeared with the monster. The corials pulled into the middle of the stream, and the eyes of the Indians directed to all points to detect the arrow-feather appearing. Their quick eye saw it above the water, although it was only for a moment. Away went all the corials in full chase, and just as it appeared the second time a second arrow was sent into the fish. All was now excitement, and the yell of the Indians, the rushing of the waters, harrowed up by the quick stroke of the paddles, was one of the most enlivening scenes I ever witnessed. Away we went where the experienced hunters expected the fish to appear, and scarcely made the tops of the arrows their appearance, when others flew from their strings and pierced the arapaima. Down he went again, but the period he remained below the surface was much shorter than previously—a proof that he got fatigued—and when he reappeared he allowed the first corial to come so near that one of the Indians was enabled to give him a stroke with a cutlass. A few more arrows were discharged at him, and he became an easy prey. The question was now how to get him into a corial, as we estimated his length at least six to seven feet, and his weight not less than a hundred and fifty pounds. He was floated into comparatively


THE LOACH (*Cobitis barbatala*).

shallow water, and when one of the corials was got under him, the Indians who were wading in the water shuffled the corial with the fish and water in it to and fro, until the water had got mostly out and the craft commenced to float again ; the rest was baled out, and under the huzza of our Indians we returned with our prize to Curassawaka, highly delighted with our sport of hunting the arapaima."

The family CLUPEIDÆ is one of great importance, and the species are scattered over the globe. The Pilchard (*Clupea pilchardus*) is taken in vast numbers on the south coast of England. A fisherman, alive when the record was made, was once at the taking of 2,200 hogsheads of pilchards in one seine ; and an instance has been known where 10,000 hogsheads have been taken on shore in one port in a single day, thus providing for human sustenance no fewer than 25,000,000 of these fish. The number of pilchards in each hogshead is 2,500.

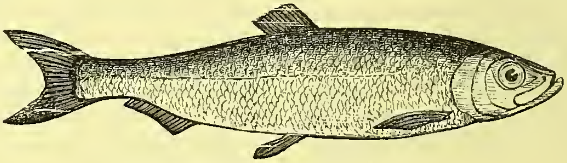

THE PILCHARD (*Clupea pilchardus*).

The Herring (*C. harengus*) is of great and even national importance. It spawns towards the end of October or beginning of November ; and for some months previously they come near our coasts in immense shoals, of which vast numbers are captured. The capture on the Scottish coast in a favourable year is over 430,000,000. On the coast of Norway nearly as many are taken. The Swedish fishery at Gottenburg yields 700,000,000, and the total of these numbers is probably surpassed by the amount taken by the Irish, English, Dutch, French, and Germans. So that it is hard to form a conception of the quantity of human food derived from this little fish.

A visit to a herring-fishery on the west coast of Ireland is thus described by the author of "Wild Sports in the West":—"Having lighted our pipes and procured our boat-cloaks, we left the pier-head in the four-oared galley. The night was unusually dark and warm ; not a breath of wind was on the water ; the noise of the oars springing in the coppered rullocks was heard for a mile off, and the whistle of sandpipers and curlews, as they took wing from the beach we skirted, appeared unusually shrill. Other noises gradually broke the stillness of the night. The varied hum of numerous voices, chanting the melancholy songs which are the especial favourites of the Irish, began to be heard distinctly, and we soon bore down upon the midnight fishers, directed by sound, not sight.

"To approach the fleet was a task of some difficulty. The nets, extended in interminable lines, were so frequent, that much skill was necessary to penetrate this hempen labyrinth without fouling the back ropes. Warning cries directed our course, and with some delay we threaded the crowded surface, and, guided by buoys, found ourselves in the very centre of the flotilla.

"It is an interesting scene. Momently the boats glided along the back ropes, which were supported at short intervals by corks, and at a greater by inflated dogskins, and, raising the curtain of network which these suspended, the herrings were removed from the meshes and deposited in the boats. Some of the nets were particularly fortunate, obliging their proprietors to frequently relieve them of the fish ; while others, though apparently stretched within a few yards, and consequently in the immediate run of the herrings, were favoured but with a few stragglers ; and the unemployed fisherman had to occupy himself with a sorrowful ditty, or in moody silence watched the dark sea, like some dull ghost waiting on Styx for waftage.

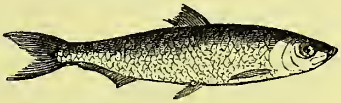

THE HERRING (*Clupea harengus.*)

"Our visit appeared highly satisfactory ; every boat tossed us herrings on board, until we were obliged to refuse further largess ; and these many 'trifles of fish' accumulated so rapidly that we eventually declined receiving other compliments, or we might have loaded the gig gunnel deep.

"The darkness of the night increased the scaly brilliancy which the phosphoric properties of these beautiful fish produce. The bottom of the boat, now covered with herrings, glowed with a living light, which the imagination could not create and the pencil never imitate. The shades of gold and silvery gems were rich beyond description; and much as I had heard of phosphoric splendour before, every idea I had formed fell infinitely short of its reality.

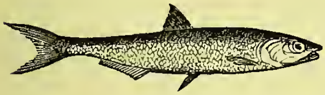
"The same care with which we entered disembarrassed us of the midnight fishing; every boat we passed pressed hard to throw in a cast of okuddawns (herrings) for the strange gentleman; and such was the kindness of these hospitable creatures, that, had I been a very Behemoth, I should this night have feasted to satiety on their bounty.

"The wind, which had been asleep, began to sigh now over the surface, and before we had cleared the outer back ropes the sea-breeze came curling the midnight wave. The tide was flowing fast, and having stepped the mast, we spread our large lug, and the light galley slipped speedily ashore."

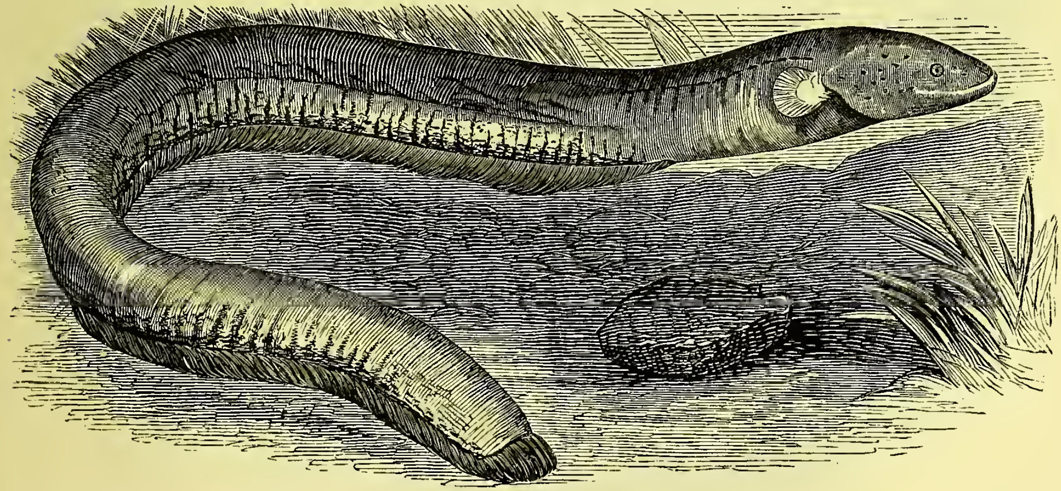

THE SARDINE (*Clupea sardinia*).

The Sardine (*C. sardina*) is very common on parts of the coasts of Brittany and in the Mediterranean. It forms a considerable article of commerce: the heads being taken off, the little fish are gutted and washed, then boiled for a few moments in olive oil; next they are thoroughly well drained and packed lightly in boxes. These are filled in with the finest quality of olive oil, and then hermetically sealed.

The Anchovy (*Engraulis encrasicholus*) is a rare British fish, but is common along the coasts of France, Spain, Portugal, and from Gibraltar to Greece.


THE ANCHOVY (*Engraulis encrasicholus*).

Passing over several small familes, we come to that of the GYMNOTIDÆ, of which we must mention the Gymnotus (*Gymnotus electricus*). Next to the Torpedo, it is the most famous among electric fishes, and it is by far the most powerful. The shock, indeed, of a large gymnotus is so severe, that no lover of heroic remedies, having one at command, need long for a magneto-electric coil machine. Several species or varieties of the fish occur, as Humboldt tells us, in the large rivers of South America—the Orinoco, the Amazon, and the Meta—besides frequenting their tributaries and the smaller streams of an extensive bordering region. They have, accordingly, been familiar for centuries to the Indians, who are constantly reminded of their presence, even in rivers too deep to let them be caught or frequently seen, by the shocks which they feel when bathing or swimming in the river. The shallower streams, also, and basins of stagnant water, near the sources of the Orinoco and elsewhere are, in this writer's words, "filled with electrical eels," so that their shock-giving powers are forced upon the attention of all visiting those districts; and we cannot

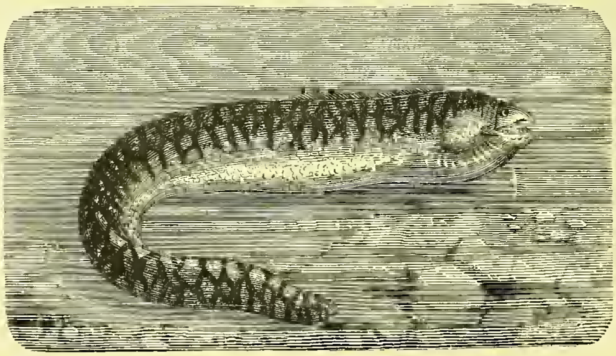

THE GYMNOTUS (*Gymnotus electricus*).

but feel curious to know whether any therapeutic use has ever been made of living machines so powerful. At first sight, it might appear that their very power had prevented their use. Humboldt mentions that "the dread of the shocks caused by the gymnoti is so great, and so exaggerated among the common people, that during three days we could not obtain one, though they were easily caught, and we had promised the Indians two piastres for every strong, vigorous fish." And that this fear, however exaggerated, is in the main well founded, is rendered certain by the unexceptionable testimony of Humboldt himself, not only in his famous account of the battle between the wild horses of the savannas and the gymnoti, whose favourite pools they reluctantly invaded, but also in his description of the effect of a gymnotus-shock received in full force by himself.

"It would be temerity," says he, "to expose ourselves to the first shocks of a very large and strongly-irritated gymnotus. If by chance a stroke be received before the fish is wounded or wearied by long pursuit, the pain and numbness are so violent that it is impossible to describe the nature of the feeling they excite. I do not remember having ever received from the discharge of a large Leyden jar a more dreadful shock than that which I experienced by imprudently placing both my feet on a gymnotus just taken out of the water. I was affected the rest of the day with a violent pain in the knees and in almost every joint. To be aware of the difference that exists between the sensation produced by the voltaic battery and an electric fish, the latter should be touched when they are in a state of extreme weakness. The gymnoti and the torpedoes then cause a twitching of the muscles, which is propagated from the part that rests on the electric organs as far as the elbow. We seem to feel at every stroke an internal vibration, which lasts two or three seconds, and is followed by a painful numbness. Accordingly, the Tamanac Indians call the gymnotus, in their expressive language, *arimna*, which means something that deprives of motion!" We cannot wonder, then, that the Indians who had had experience such as Humboldt underwent, and who, unlike the philosopher, were acquainted with the limits within which the shock-giving power of the gymnotus is restricted, should be unwilling to provoke its anger.

The family MURÆNIDÆ is the last to be mentioned of this order. It contains over 240 species, most of which are marine, though a few are fresh water. Of the British species we select the Eel, of which we have two species (*Anguilla acutirostris* and *A. latirostris*), and the Conger (*Conger vulgaris*). The Muræna (*Muræna helena*) has been at least once taken on the English coast. It is very common in the Mediterranean. Its flesh is delicate and agreeable. It was a great favourite with the ancient Romans, who preserved large quantities of them in their vivaria, where they were fed with great care. Cæsar is said to have made presents of 6,000 specimens among his friends on the celebration of one of his triumphs.

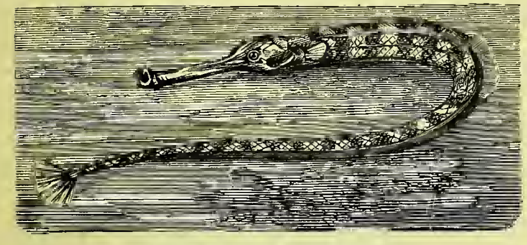
The family PEGASIDÆ contains only four species, which used to be placed in the next order. One of these (*Pegasus volans*) is often to be met with among the collections of dried insects put up in China for this country.



THE MURÆNA (*Muræna helena*).

ORDER V.—LOPHOBRANCHII.

In this order the gills are not arranged on the gill-arches like rows of fringe, but are composed of little tuft-like masses. The gill-cover is reduced to a large simple plate. The external skeleton is composed of many pieces arranged in segments. The mouth is placed at the end of a long snout, and is small, and, like that of the previous order, it is toothless.

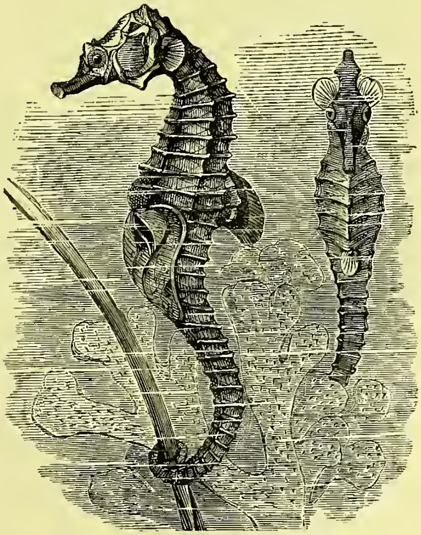


THE PIPE FISH (*Syngnathus acus*).

This order contains the family of the Pipe Fishes, or Syngnathidæ, which numbers over a hundred species of these curious little fish. They are mostly all marine, though a few enter fresh water, and a few live altogether in it. Perhaps the commonest British species is the Great Pipe Fish (*Syngnathus acus*), which is frequently to be met with also on the south-west coast of Ireland. This fish is often kept by the fisherman in a dried state to sell as a curiosity to sea-side visitors. It is from one to two feet in length, when fully grown, and is of a pale yellowish-brown, with dark and broad bands at regular intervals. "This species," says Mr. Couch, "may be seen slowly moving about, in a singular manner, horizontally or perpendicularly, with the head downwards or upwards, and in every attitude of contortion, in search of food, which seems chiefly to be crustacea." Mr. Yarrell observes, that these fishes "are supposed to be able, by dilating their throat at pleasure, to draw their food up their cylindrical beak-like mouth, as water is drawn up the pipe of a syringe." The male of this species is furnished with a pouch.

Another funny-looking species is the Sea Horse (*Hippocampus brevirostris*). Its head resembles somewhat that of a hog or tapir, with a slender tubular snout, at the end of which is a small mouth. The neck is arched like that of a horse, and the protuberant abdomen may represent the chest; the tail is long, tapering, and prehensile; the dorsal fin is high; the mail-clad body and tail are traversed by longitudinal and transverse ridges, with angles of intersection. It is to be met with now and then on different parts of our coasts. Its general colour is a pale brown, with changeable iridescence, and variable tints of blue. Its total length is about five inches. The males are furnished with a pouch at the base of their tails.

Specimens of this fish have, it is said, been occasionally found curled up in oyster-shells. Mr. Lukis had two female specimens living twelve days in a glass vessel; their actions being equally novel and amusing. "An appearance of search for a resting-place induced me," he says, "to consult their wishes by placing seaweed and straws in the vessel. The desired effect was attained, and has afforded me much to reflect upon in their habits. They now exhibit many of their peculiarities, and few subjects of the deep have displayed in prison more sport or more intelligence.



THE SEA HORSE (*Hippocampns brevirostris*).

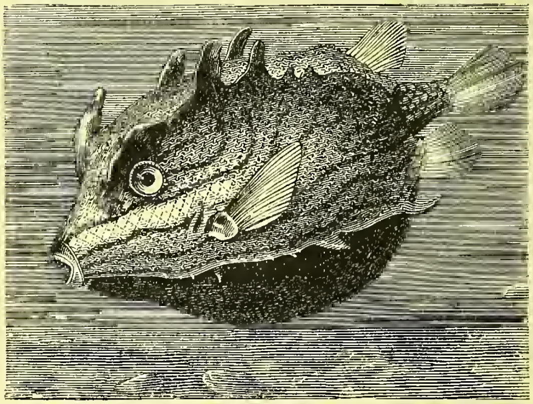
"When swimming about they maintain a vertical position, but the tail is ready to grasp whatever it meets in the water, quickly entwines in any direction round the weeds, and when fixed the animal intently watches the surrounding objects, and darts at its prey with great dexterity.

"When both approach each other, they often twist their tails together, and struggle to separate or attach themselves to the weeds; this is done by the hinder part of their cheeks or chin, which is also used for raising the body when a new spot is wanted for the tail to entwine afresh. The eyes move independently, as in the chameleon. This, with the, brilliant iridescence about the head, and its blue bands, forcibly remind the observer of that animal."

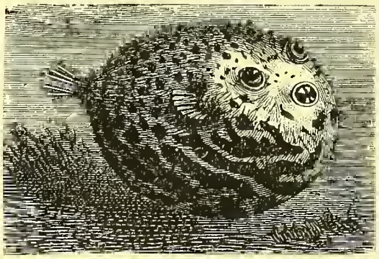
ORDER VI.—PLECTOGNATHI.

THIS order contains nearly two hundred species of fish. Their skin is generally provided with rough scales, or with ossified scutes or spines, or in some it is quite naked. The skeleton is incompletely ossified; the gills are pectinate; the mouth small, and the bones of the upper jaw are generally firmly soldered together. The ventral fins are sometimes reduced to mere spines, or are absent. There are but two families.

That of the SCLERODERMI contains about one hundred species. They are marine with toothed jaws. Of the species we can only mention the File Fish (*Balistes capriscus*), which is occasionally captured off the Irish and British coasts; and those remarkable fish called Box Fishes, belonging to the genus Ostracion. These are chiefly to be met with in the tropical seas. We figure one that used to be very common in the sandy bays of the Seychelles (*O. cornutus*). It was often taken in drawing in the seine net, and some of the specimens were over a foot in length.


THE BOX FISH (*Ostracion cornutus*).

The species of the next family, GYMNODONTES, are mostly marine, but some few are fresh water. The bones of their jaws are confluent, and form a prominent beak. Some of the species grow to an immense size. In one section of the family part of the swallow (œsophagus) is capable of great distention, and can be filled with air. When frightened the fish can gulph this in, and swells itself out in a wonderful way. Here we find the so-called Globe Fishes (*Diodon*). The Spiny Globe Fish (*D. hystrix*) is one of the commonest species in the tropical parts of the Atlantic, Indian, and Pacific Ocean, while Tetrodon lagocephalus has been taken on the Irish and British coasts, and is very common at the Mauritius.


THE GLOBE FISH (*Diodon hystrix*).

In another section of this family we find the body compressed, shortened, and it is not extensible by the inspiration of air. Here are placed the Sun Fishes. The Short Sun Fish (*Orthagoriscus mola*) is not rare on the west coast of Ireland, and specimens have been met with weighing over 300 lbs. It probably feeds on seaweed and crustacea. It swims with its back fin over the water. The Oblong Sun Fish (*O. oblongus*) is a rarer species, but larger.

SUB-CLASS II.—DIPNOI.

In this sub-class we have fishes with the skeleton partly cartilaginous and partly bony. The air-bladder is divided lengthwise into two parts, and is more or less lung-like. The gills are free; but some of the gill-arches have no gills. There is a narrow gill-opening on each side with a rudimentary gill-cover. The nostrils are double on each side, and the intestine has a spiral valve. This sub-class contains but one order and one family.

ORDER VII.—SIRENOIDEI.

THE characters of this order are those of the sub-class, as enumerated on p. 456. The family PROTOPTERIDÆ contains three genera, each with a single species. The African Mud Fish (*Protopterus annectens*) is an eel-shaped fresh-water fish, found in the tropical portions of the Rivers Nile, Zambesi, and Gambia. In its native region, where it abounds, this creature dwells, during the hot and dry months, in the mud of the swamps along the Gambia, making for itself a convenient cavity, in which it remains, coiled up and dormant, till the return of the rainy season. Sometimes the case is almost or entirely composed of dry leaves, agglutinated together by the mucous secretion of the body. Mr. Daniel, who lived during several years on the Gambia and on Macarthy's Island, informed Dr. Gray that it is found only in the rice-fields, which are for more than half the year under water, and that they are procured by the natives towards the end of the dry season, when they are dug out of the nearly dried mud.

The second species is met with in the River Amazon and its tributaries. It (*Lepidosiren paradoxa*) differs, among other things, from its African congener, in having no external branchial appendages, and in having five, instead of six, gill-arches, and four, instead of five, intervening clefts.

The third species is found in Queensland, and is one of the most interesting fishes known. It (*Ceratodus forsteri*) is a living representative of a genus, of which, until 1869, nothing was known but a few teeth, described as fossils by Agassiz, from the muschel kalk.

"It is strange," writes Dr. Günther, "that a curious creature like this, which was well known to the early settlers at Wide Bay and other Queensland districts, should so long have escaped the eyes of those interested in natural history. I remember that Mr. William Forster mentioned a 'fish' with cartilaginous backbone, years ago, and that I expressed an opinion that he must be mistaken. This animal is excellent eating, has salmon-coloured flesh, and at certain seasons will rise to a fly; so that the northern squatters have named it the Bromett, or Dawson Salmon, from its habits and from the rivers in which it is principally found. The poor bush-coolies who dressed these 'salmons' could have made a small fortune, had they preserved the heads and sent them to Sydney.

"It is only during certain seasons that this amphibian takes bait; at other times it cannot be induced even to nibble. I think, however, that during this latter period the animals are buried in the mud. The native name is Baramoonda, or Baramoondi. We know as yet nothing about its habits, or the metamorphoses the young undergo; and I have been informed that the specimen from which the present description is taken is by no means a large one. Mr. Forster tells me that he has heard of specimens taken in the Dawson being fully six feet in length."

SUB-CLASS III.—GANOIDEI.

The fishes of this sub-class have their skeletons more or less ossified. Their gills are free, and the gill-cavity is protected by a gill-cover. The intestine has a spiral valve. The body is either covered with scales or with thick bony plates.

ORDER VIII.—HOLOSTEI.

IN this order of the Ganoids the skeleton is bony, and the body is covered over more or less with an armour of scales. All the species are fresh-water.

The family AMIIDÆ contains but a single species (*Amia calva*), to be met with in the fresh waters of the United States of America. It grows to a length of from one to two feet.

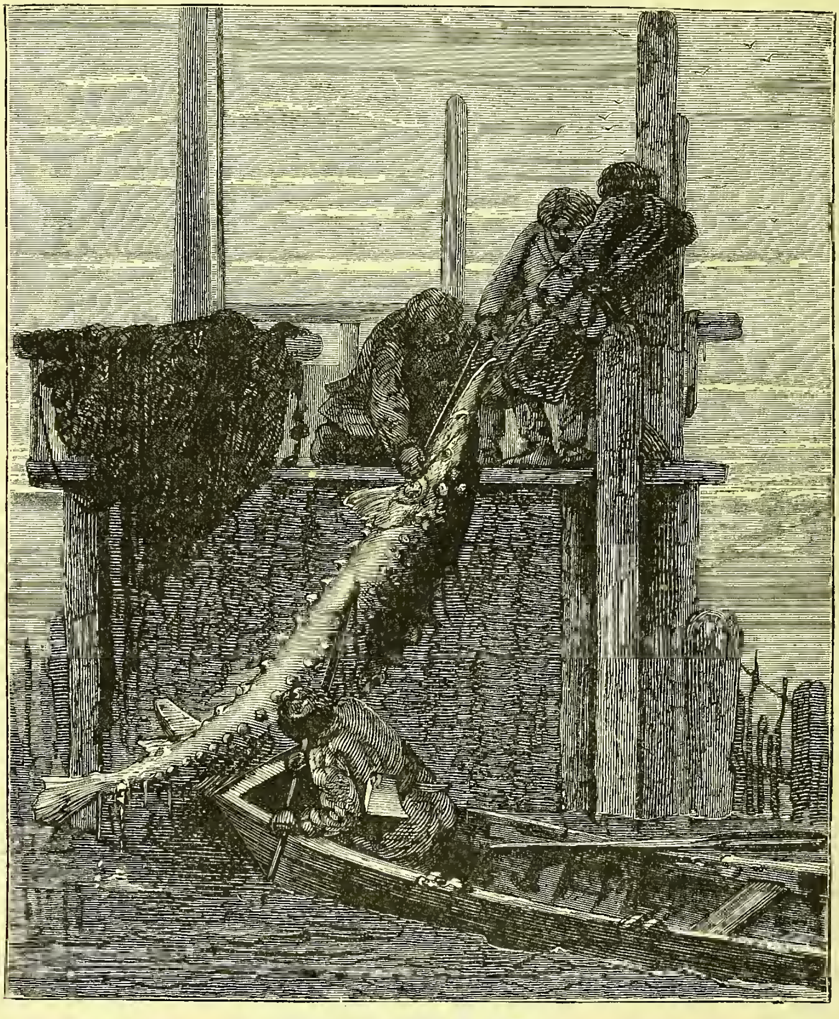
The family POLYPTERIDÆ contains two genera and two species, both African. The Bichir (*Polypterus bichir*) is found in the Nile at Cairo, and in the Gambia. It grows to a length of thirty-two inches, and has well-developed ventral fins. The second species (*Calamoichthys calabaricus*) has no ventral fins, and has as yet only been found at Old Calabar.

The third family, LEPIDOSTEIDÆ, contains only three species, all of them peculiar to America. These are known as the Bony Pikes. Like the species of the previous family, they are densely covered over with ganoid scales, which are more or less lozenge-shaped. Lepidosteus viridis is found in Cuba, as well as in Mexico and North America. L. osseus grows to a length of five feet, and is not very rare in Florida and Louisiana, in which latter State the third species, L. platystomus, is also found.

ORDER IX.—CHONDROSTEI.

In the fishes of this order of Ganoids the skeleton is for the most part cartilaginous. The skin is often covered with bony plates like bucklers; but in one genus it is naked. The caudal fin (tail) is of the form known as heterocercal. They are for the most part inhabitants of the arctic or temperate regions. There are but two families.

That of the Sturgeons, or Accipenseridæ, according to Günther, contains about twenty species. They are inhabitants of the seas of the temperate and arctic regions of the northern hemisphere, periodically entering rivers to propagate; but some live entirely in fresh water. In most the rows of bony plates are separate; but in a fine North American species (*Scaphirhynchus cataphractus*) these bony plates form a solid mass encasing the tail. The geographical distribution of the sturgeons is, says Dr. Günther, nearly identical with that of the true Salmon.



STURGEON FISHING IN RUSSIA.

The Common Sturgeon (*Accipenser sturio*) is often taken on various parts of our coast, and in the estuaries of rivers, where it is sometimes entangled in the salmon nets. Its struggles are very desperate, and it sometimes occasions much trouble. The flesh of this fish, which is sold in slices, is much esteemed by many. It is firm and pink, and generally prepared as a stew, with a rich gravy; it is also preserved by salting. The roe of the sturgeon when salted is, in Russia, called *caviar*, and the best isinglass is prepared from the membrane of the air-bladders. In the Caspian Sea, and in the northern districts of Europe, extensive sturgeon fisheries are established, the roe and air-bladder being the great desiderata. The Russian fisheries on the Caspian Sea are extremely valuable. The fishery of the sturgeon begins in April. The lines laid down are on the same principle as the bulters and snoods described as made use of in cod-fishing, but of course the tackle is of far greater strength. These lines are examined twice a day, the fish which are caught are disengaged, and when a rope from shore is passed through their gills they are put into the water, to be kept alive till the time for cutting them up arrives. A single vessel will sometimes capture fifty of these fish in twenty-four hours. The work of cutting up these fish is managed on planks, along the shore. The sounds are obtained by the isinglass makers; the roe is put into tubs, of which the preparers of caviar take the charge; the fish are then cleared of refuse, cut up, and put in layers into brine vats in underground cellars, for the sake of coolness; after this, they are taken out, again sprinkled with salt, and placed on layers in store cellars lined with ice. One or more large vessels are continually passing to Astracan from the fisheries and back again, bringing salt and needful implements, and returning with salt-fish, caviar, isinglass, and fish-skins, which latter, in some parts of Russia and Turkey, are made into a sort of leather, or used, when prepared, instead of window-glass.

After the spring fishery of the great sturgeon is over, that of the small sturgeon commences, and lasts about a fortnight. This fish is very abundant, and a single fishing-vessel sometimes takes from fifteen to twenty thousand. The total number taken in one season has been calculated at 1,300,000, affording the value of £16,000 in isinglass, and £40,000 in caviar. Of the common sturgeon, the number captured amounts to 300,000, yielding in isinglass £6,500, and in caviar, £10,000.

Late in the autumn, and during the winter, a second fishery of the great sturgeon is carried on. Large holes are cut in the ice, for the introduction of the apparatus of lines and hooks, and the fish, when caught, are sent off direct, in a frozen state, to Astracan, by means of sledges.

It has been calculated that the spring and winter fisheries of the great sturgeon produce, annually, 103,500 fish, which afford 30,000 lbs. of isinglass, and 414,000 lbs. of caviar.

The common sturgeon of our seas sometimes attains to an enormous size. One recorded by Pennant, which was caught in the Esk, weighed 460 lbs.; and in 1802, a specimen, eight feet long, was caught in a weir below the castle of Shrewsbury, and weighed 190 lbs. The mouth of the sturgeon is destitute of teeth, and it is said to feed principally on molluscs, and various soft substances it may find at the bottom of the water. The under side of the snout is garnished with four barbules, or feelers.

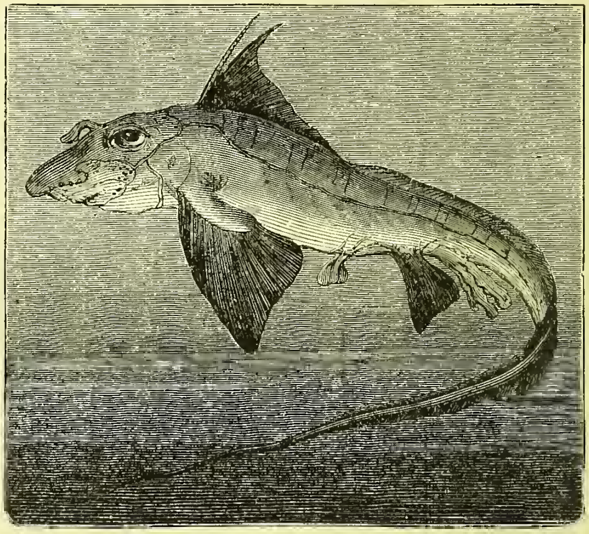
The second family, POLYODONTIDÆ, contains two strange fishes. One (*Polyodon folium*) is found in the Mississippi. It has an elongate, rather compressed body, which has on it a few very minute star-like bony particles. The snout is produced into an exceedingly long, shovel-like process, thin and pliable on the sides. The mouth, which is a tremendously wide one, is beneath this projection. This shovel-like process is about one-fourth of the entire length in an adult fish, which attains a length of upwards of five feet. Another species (*P. gladius*) has been found on the Yantse-Kiang.

SUB-CLASS IV.—CHONDROPTERYGII.

The fishes belonging to this sub-class have a perfectly cartilaginous skeleton; the parts of the skull are not united by sutures. The caudal fin is generally well developed, and of the form described in our introductory chapter as heterocercal. The gill-openings vary in number. There is but one in Chimæra, while there are from five to seven in the sharks and rays. There are no gill-covers, and there is no air-bladder. The intestine has a spiral valve. The eggs laid are in number few, and they are often developed internally. They are sometimes enclosed in strong, horny capsules, which in some cases are attached by means of tendril-like bodies to marine plants. With the exception of a few sharks and a few species of the family Trygonidæ, the fishes of this sub-class are all marine.

ORDER X.—HOLOCEPHALA.

The few fishes at present living that belong to this order may be easily distinguished from those of the next order by their having but one external gill-opening, which is more or less covered by a thin fold of skin, inside of which there is a rudimentary cartilaginous gill-cover. The gill-cavity contains four gill-clefts. It contains but a single family, that of the Chimæridæ, shark-like fishes, but with naked, shiny skins, and the males having a very peculiar prehensile organ on the upper part of their snouts. There are but four species known, and these belong to two genera. One, the Northern Chimœra (*Chimœra monstrosa*), is a very strange-looking fish, which was figured by old Gesner as a marine ape. It is common in the Mediterranean, and is to be found in the Atlantic from the north of Norway to the Cape of Good Hope. The Norwegians call it the gold and silver fish, in reference to its beautiful colours, which are various shades of rich brown on a shiny white ground. It has large brilliant eyes, with green pupils and white irides. The females lay large eggs, which are covered with a horny shell flattened on the edges, and velvety. It feeds principally on herrings, though it will eat crustacea. The Italian and Norwegian fishermen believe the oil of its liver to be of singular efficacy in some ophthalmic affections. The Southern Chimœra (*Callorhynchus antarcticus*) is also a strange and yet beautiful fish, which is found in the Southern Pacific Ocean.



THE CHIMÆRA (*Chimæra monstrosa*).

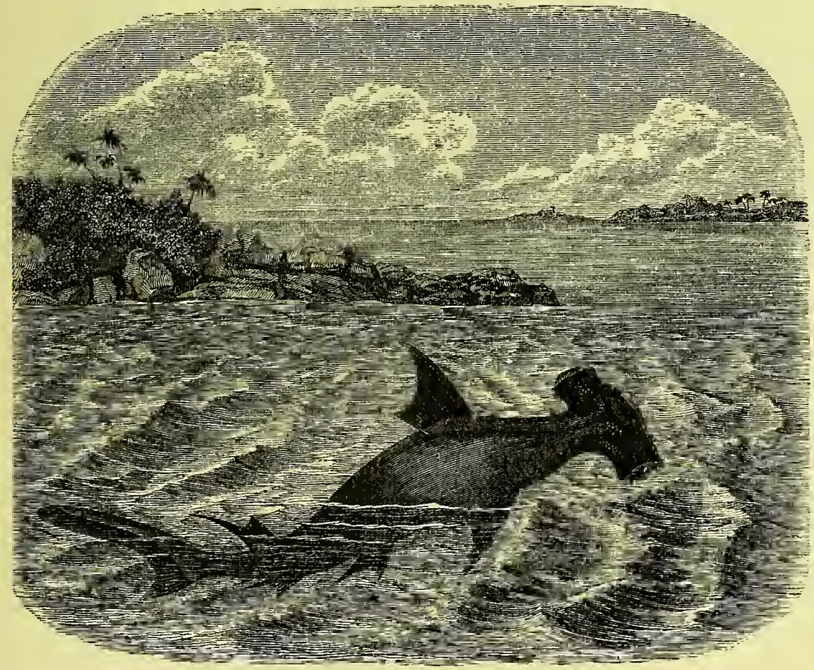
ORDER XI.—PLAGIOSTOMATA.

This order contains the Sharks and Rays; and their gill-openings are from five to seven in number. The centre of their vertebral column is often more or less ossified, and even where the dorsal cord (chorda dorsalis) exists; yet each vertebra is more or less indicated. The mouth is very large, and placed on the lower surface of the body. The snout is generally large, so as to afford room for the large nose capsules. The gills are placed on the sides of the neck in the sharks, on the lower surface of the body in the rays. The skin is generally covered with either spines or minute hardened granules. About 260 species are known, which Dr. Günther arranges in fifteen families. Of these space will allow us only to mention the following:—

The True Sharks, or Carchariadæ, form a family most numerous in species, which are to be found in all seas. Of British species we may mention the Blue Shark (*Carcharias glaucus*) as common in the Mediterranean, and it is frequently taken off the south and west coasts of Ireland, and on the south coasts of England. It grows to a length of upwards of eleven feet; and sometimes it inflicts a good deal of damage on the herring-nets. The Gangetic Shark (*C. gangeticus*) inhabits the river from which it takes its name, up beyond Calcutta, and has even been found in fresh water in the Island of Viti Leva. The Tope (*Galeus canis*) is a very common species on the southern coasts of the British island. It sometimes attains a length of six feet; but one of the commonest British species is the Smooth Hound (*Mustela vulgaris*).

The strange Hammer-headed Shark (*Zygœna malleus*), though a native of the warmer portions of the Atlantic and Indian Oceans, yet wanders sometimes to the south coasts of our islands. It grows to a length of upwards of twelve feet, and has the anterior part of its head broadly-flattened, and extended right and left until it has quite a hammer-like appearance. On the extremity of these lobes the eyes are placed. It sometimes enters fresh-water streams in pursuit of fish.

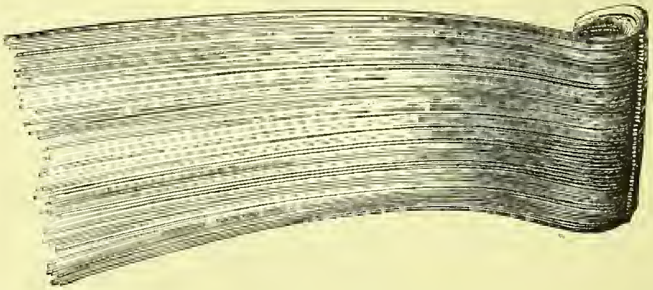
The next family, LAMNIDÆ, contains seven or eight species; but several of them are of great size. The Porbeagle Shark (*Lamna cornubica*) occurs occasionally on the southern coasts of England, and on the south and west coasts of Ireland. It measures from seven to eight feet in length, and is to be found in the Atlantic Ocean, throughout the Mediterranean, &c. The Fox Shark, or Thresher (*Alopecias vulpes*), is occasionally met with on the British coasts, where specimens have been seen fifteen feet in length; but this is but a small shark when compared to the last species we can allude to, the Great Basking Shark (*Selache maxima*). This shark attains to a length of more than thirty feet, and shark though it be, it would appear, like many other big animals, to be of a gentle, mild, and placid disposition, to be fond of sunning itself on bright days, and to never interfere with mankind unless they interfere with it; and yet with all these facts in its favour, the animal being, so to speak, common, having local names, being of a size not easily overlooked, and not being like its cousin, the Blue Shark, a man-eating devil, this Selache maxima was very little heard of and less known until the other day. Even a short time ago Dumeril, in his "Ichthyologie Générale," could with truth have written about the specimen in the museum at Paris as he wrote ten years ago:—"Il semble être, jusqu'à présent, le seul représentant dans les Musées de l'Europe centrale, de cette énorme espèce des mers du Nord." To this moment nothing very exact is known as to its food. Pennant thought it fed on marine plants. Linnæus considered its food to be medusæ; some fishermen foolishly think it lives on herrings; and as to its times and seasons nothing is known. Why does it come from north to south, and why then go north again? So little being known about its forms and habits, it is not much to be wondered at that very little is known about its anatomy; and yet Sir Everard Home wrote an anatomical account of it, which is to be found in the *Philosophical Transactions* for 1809, in which he tells us that he found in the stomach of this fish structures showing a link in the gradations of animals between the whale tribe and the cartilaginous fishes. Why, to work out this idea alone



THE HAMMER-HEADED SHARK (*Zygæna malleus*).

ought to send the comparative anatomists off at once to Tory Island or Bofin. We would, however, refer to another anatomical peculiarity, which, had it been known to Sir E. Home, would doubtless have clenched his argument, namely, the presence of rays or fringes of a whalebone-like substance along the gill-openings. It is true that Gunnerus, in 1766, refers to these strange fringes; it is true that in the museum of that far north city of Trondhjem—and within view of the woudrous old cathedral where Gunnerus lies buried, and where to this day Norway's kings are crowned—there is to be seen a piece of one of them; that other northern museums, those of Christiania, Kiel, and Copenhagen also possess pieces, and equally true, that during all these days Gunnerus' statements had been overlooked, and these fringes were a puzzle to every one who examined them. Professor Hanover, indeed, in 1867, from their minute structure, described them as teeth-like, and thought they were planted on the outside of the fish's skin, like the long spines of certain rays.

Professor Streenstrusp, in whose charge the specimen we figure is, and to whose kindness we are indebted for the accompanying figure, having made up his mind that it did belong to the basking shark, proceeded to work out its history, and so came upon Gunnerus' description, which enabled him to suggest that this shark must have the interior of its mouth furnished with branchial fringes of a peculiar nature. He further argued that these must act as strainers; that the shark takes in whole volumes of minute food, catches it on these fringes, and then swallows it. He declares it to be a great mistake to call this fish a carnivore, that is, if it eat flesh at all, it is small flesh, not big flesh. He then objects to the writer of these lines, when describing a shark found in the Seychelles—" which is, the north whale excepted, the largest of living animals"—saying, " contrary to the habits of sharks, this one is not a carnivorous, but a herbivorous fish," as being too much on the other extreme. My excellent friend is right, and I have now no doubt that both these big, lubberly beasts—which in their mouth have scarcely more than the name of teeth—feed on all sorts of minute oceanic creatures, frequently taking in with them floating algæ. And he will be glad to know that, acting on the hint in his paper, when Mr. Cullen, the assistant in the Trinity College (Dublin) Museum, went down to Bofin in May of last year, to preserve for Dr. Carte the specimen now in the Dublin Museum, the first thing he did was to put his hand into the still quite fresh branchial openings, when he at once felt what Gunnerus felt in 1766—the whalebone-like fringes.



The gill-openings are five in number, on each side of the neck. The first pair almost meeting on the top of the back. A thought here strikes us. As a rule these gill-slits in the large sharks are small, here they are of immense size. Their function is to allow of sufficient water to flow in and over the gills to oxygenate the fish's blood; but in Selache they serve also as supports to the strainers; and as so big a body must require a great lot of food, the in-takings and out-puttings must be great, and might account for the gradual increase in the size of these slits until they reach their present immense proportions, where they have to subserve both the functions of nutrition and circulation. The convexity of the gill-openings is towards the shark's mouth, the concavity of these fringed rays is in the same direction. The edge represented in the drawing as jagged—an appearance assumed in drying—is attached to the inner edge of the flaps covering the gill-openings, being somewhat more firmly attached towards the central portion, which in the drawing is far too cartilaginous-looking. The gills are outside the whalebone fringes. There seems little reason to doubt but that the free points of the fringes of the one row can be so erected from its gill ray edge as to bend forwards and join, and perhaps slightly interlace with those of the opposite row, and thus there would be a series of arches of whalebone protruding into the neck cavity of the fish. When these fringes are applied to the surface of the gill rays, the water could flow without resistance. The gills were quite free from parasites, in this respect differing from the gills of the Rhinodon, of the Seychelles. Although this is not the place to enter into minute details, there is little doubt that Dr. Fleming is wrong in stating that the skin seems smooth when the hand is passed from the head to the tail; and yet, though the scales are, as described by Dr. J. E. Gray, armed with small curved points bent in all directions, so that the skin feels rough each way, the hand can be rubbed several times more easily from head to tail than from tail to head; indicating that a larger number of the curved points are directed towards the tail.

The oil from the liver of a medium-sized basking shark is worth nearly £40 sterling; but the difficulties and danger of capturing these sharks seem altogether to be greater than those attending whale-fishery. The same was true at Seychelles. Men engaged at the sperm-whale fishery off St. Denis often told me they dreaded to harpoon by mistake a Rhinodon. A whale must come up to breathe, or else choke itself. But there were stories told me of how a harpooned Rhinodon, having, by a lightning-like dive, exhausted the supply of rope, which had been accidentally fastened to the boat, dived deeper still, and so pulled pirogue and crew to the bottom; there, in spite of the harpoon in its neck and its attendant incumbrances, it was at home for a great length of time.

These curious fringe-like bodies had long ago been noticed by Professor Allman, the President of the Linnæan Society, but his account of them had been overlooked owing to their having been published in a daily newspaper. They have also been well described by Professor Pavesi, of Pavia, and my friend Dr. Capello of Lisbon.

The family RHINODONTIDÆ is remarkable as containing the largest fish known. This shark (*Rhinodon typicus*) was met with by me between Silhouette and the eastern coast of Mahè. I had often heard stories of this monstrous fish, but at first I attached as little credit to them as I do to the stories told by Bishop Pontoppidan about the "Kraken;" however, Mr. Ward having measured one that somewhat exceeded forty-nine feet in length, I felt bound to believe this evidence, longing all the while to corroborate it by my own personal experience. This I was able to accomplish, and, thanks to Mr. Ward's exertions, and to the offer of a reward of twelve dollars for the first specimen, successfully harpooned and brought to shore, I was enabled to take photographs of two specimens, male and female, of this remarkable shark. This shark, which is—the north whale excepted—the largest of living animals, would appear to have a very limited geographical distribution, and, contrary to the general habits of the true sharks, is not a carnivorous but a herbivorous fish. I have seen specimens that I believe to have exceeded fifty feet in length, and many trustworthy men, accustomed to calculate the length of the sperm whale (one of the most important stations for this cetacean is off Ile Dennis, one of the Seychelles group), have told me of specimens measuring upwards of seventy feet in length. It is a quiet, harmless fish, with a mouth of immense width, furnished with small teeth. It now and then rubs itself against a large pirogue, as a consequence upsetting it, but, under these circumstances, it never attacks or molests the men, and while it reigns as a monster among the sharks, is not, despite its size, as formidable as the common dog-fish. A stray specimen, about seventeen feet long, was found many years ago floating near Capetown, and was named by Sir A. Smith, but it would appear that nothing more has, until now, been known about this fish.

The family NOTIDANIDÆ contains four or five species, of which one (*Notidanus griseus*) has occasionally occurred on the English coast. One specimen, twelve feet in length, is in the British Museum, which was captured off the Isle of Wight.

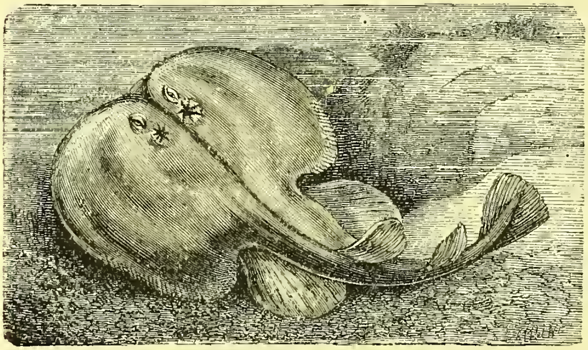
The family of the DOG-FISHES, OR SCYLLIDÆ, contains some thirty species, of which two are natives of the British Islands, and one is among the commonest of fishes. The common Dog-fish (*Scyllium canicula*) is to be found everywhere around our coasts. It takes bait freely, and is really injurious to our fishes from its voracity. Another species (*S. stellare*) is often taken on our coasts; it has larger but less numerous spots than the former species; it is also larger, attaining a length of from two to three feet. The Black-mouthed Dog-fish (*Pristiurus melanostomus*) is sometimes to be found on the British Seas. It is common in the Mediterranean.

CESTRACIONTIDÆ forms a family containing only four species, which are natives of the Pacific Ocean. The best known species is the Port Jackson Shark (*Cestracion philippi*), which is found from New Zealand to Australia, and in the East Indian Archipelago, and at Japan. Fossil remains of fishes quite nearly related to this genus are tolerably numerous in some of the older formations.

Of the Spined Sharks, or Spinacidæ, there are a good many species. The Picked Dog-Fish (*Acanthias vulgaris*) is a very common British species, indeed, Mr. Couch says it is the most abundant of the sharks, and we read that in March, 1858, a skull of this dog-fish was observed westward to Uig, from whence it extended from twenty to thirty miles seaward, and in an unbroken phalanx eastward to Moray and Aberdeen.

Centrophorus lusitanicus is remarkable for living in great depth off the coast of Portugal. The Greenland Shark (*Læmargus borealis*), which is common in the North Atlantic, and grows to a length of twenty-five feet, has been on a few occasions taken on the west of Scotland and England. This shark is the species said to attack the whale, biting and annoying it while living, and feeding on it when dead. The Spinous Shark (*Echinorhinus spinosus*) is a rare British fish, growing to a length of ten feet, and extends from the English coasts to the Cape of Good Hope.

The Monk, or Angel Shark (*Rhina squatina*), forms a family by itself, Rhinidæ. This fish is found in all temperate and tropical seas. It has a depressed, flat body, with the mouth at the end of its snout. It has large wing-like pectoral fins, from whence, perhaps, its second name. It sometimes attains a large size, specimens having been measured nearly eight feet in length. It is common on the south coasts of England and Ireland.



THE TORPEDO (*Torpedo vulgaris*).

Pristiophoridæ forms a family containing but one genus and four species. In these the snout is prolonged into a broad, flat blade, which is armed along each edge with a series of teeth. The best known of the species is the Australian Saw Fish (*Pristiophorus cirratus*). It is found in Tasmania and Southern Australia. The teeth of the saw are unequal in length. This shark is said to attain a length of about twelve feet. The fishes of this family approach in several particulars to the those of the next family, but the Australian Saw-fish has a pair of filaments hanging from the lower side of the saw.

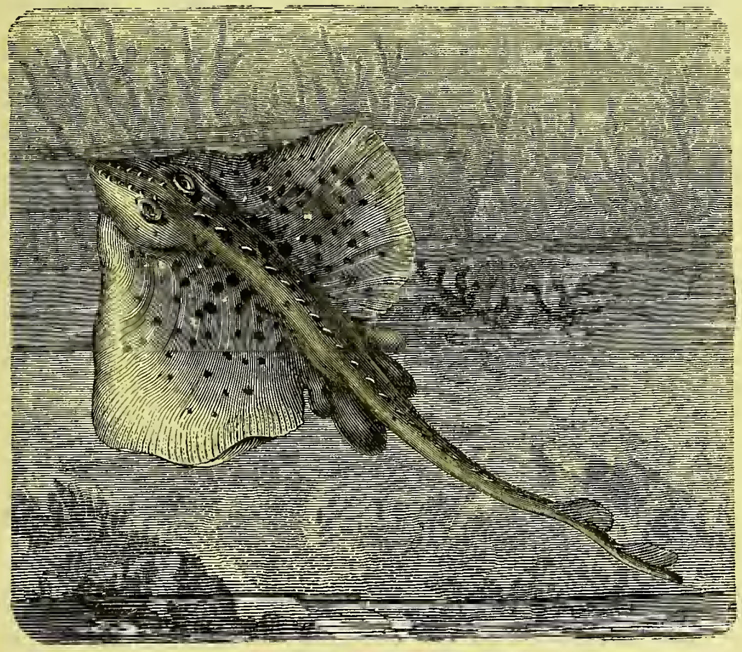
The next series of families are often formed into a sub-order by themselves; they are commonly known as Rays. In one remarkable and easily-recognised particular, the fishes belonging thereto differ from those we have already examined, in that the gill-openings in the former series of families (Sharks) were lateral, whereas in these (the Rays) the gill-openings are quite central. This difference at once forms a contrast between the Australian saw-fishes and those belonging to the next family we have to mention, that of the Saw-fishes, or Pristidæ.

The common Saw-fish (*Pristis antiquorum*) is frequently to be met with in the Atlantic and the Mediterranean. It grows to a length of about fifteen feet, and its saw will sometimes be upwards of five feet in length. Its body is somewhat depressed; the gill-openings are inwards at the base of the pectoral fin. It has no tentacles hanging from the nostrils. Many other species are to be met with in the tropical and sub-tropical seas.

The family of the Rhinobatidæ contains a few large rays, with strong, long tails, and two well-developed dorsal fins, and the body not excessively dilated. They are, for the most part, inhabitants of the tropical seas, where they often grow to an immense size. I have seen specimens of the l'Endormie, of the Seychelles (*Rhynchobatus ancylostomus*), upwards of eight feet in length, and some species of Rhinobatus probably even exceed this in size.

The family of the Torpedinidæ contains the Electric Rays. They are even less shark-like than the fishes of the preceding family; have round, smooth, disc-like bodies, and electrical organs. These consist of two glandular masses, one on either side of the head, between it and the pectoral fin. They are composed of numerous perpendicular columns, separated from each other by membranous partitions, and receiving an immense number of fine nerves, which come from the eight pair. A few species are found in the European seas, and one, at least, the Torpedo (*Torpedo vulgaris*), is found occasionally on the south coasts of England and Ireland. It is not at all uncommon in the Mediterranean, and was known to Aristotle as Νάρκη.

Of the true Rays (Rajidæ), several species are common on the British coasts. Their bodies are broad and generally covered with spines. The great pectoral fins extend to the very snout. The tail is long, and often very slender. Some of the species attain to a very great size. Among the native species are the Thornback (*Raja clavata*). Its flesh is considered good, and immense quantities of it are captured every year. Its flesh is at its best as food about November, but it is captured in greatest abundance in spring and summer, when it comes into shallow water to deposit its eggs. The teeth of the adult male differ very decidedly from those of the adult female. The Homelyn Ray (*R. maculata*) is also a very common species on our south coasts. The Sandy Ray (*R. circularis*) is also a fine species, not unfrequently found around the coasts of Ireland and England. The common Skate (*R. batis*) is, perhaps, not as common as the Thornback, but by some is regarded as better food. It grows to a great size, and there is a specimen in the Dublin University Museum which measures seven feet in length. It is found all round the coasts of Europe.



THE THORNBACK (*Raja clavata*).

The Sting Rays, or Trygonidæ, form a pretty numerous family of over fifty species. Their pectoral fins are uninterruptedly continued, and join themselves to the extremity of the snout. The tail is long and slender, and often armed with one or more strong toothed spines, from whence the name of the family. The species are found in all seas, and some of them even occur in the rivers of tropical America. One species, the Sting Ray (*Trygon pastinacea*), is not uncommon on the British coasts. It can use its spine as a weapon of offence and defence; twisting the flexible portion of its tail around the object of attack, it uncovers its stinging-spine, with which it can inflict a severe wound.

The last family of this order is that of the Eagle Rays, or Myliobatidæ. These Rays have immensely broad bodies, owing to the great development of their pectoral fins, which spread out on either side like big wings, leaving, however, the snout free. The tails are long and flexible, with serrated spine, or spines, behind the dorsal fin, which stands up from the base of the tail-like portion. Most of the species are inhabitants of tropical seas. Some of them grow to a huge size, and may well be reckoned among the monsters of the deep. Several of the very large species are known in the tropical seas as Sea Devils, and though possibly for the most part harmless, yet, when one happens to be in a small boat, as I can testify from experience, it is not pleasant to witness these gigantic beasts flapping about near it. One species, the Eagle Ray (*Myliobatis aquila*), is found from the Cape of Good Hope to the German Ocean. It enters the Mediterranean Sea, where it is not uncommon, and it has sometimes been found on the coast of England. One gigantic form, which we believe to belong to this family, and, possibly, to be an undescribed species of the genus Ceratoptera, I have met with several times off the Seychelles, and the following graphic account of the capture of one of these monsters is from the pen of my friend, Mr. Swinburne Ward, for some years the Civil Commissioner of these islands, and an ardent sportsman, in a letter to Colonel Playfair, of Algiers, the author, with Dr. Günther, of a valuable work on the Fishes of Zanzibar:—

"Coming home we passed close to an enormous 'diable-de-mer,' floating quietly about. We changed from the pirogue to the whale-boat, which I had scientifically fitted up for the *gros poissons*, and went alongside of him, driving a regular whale harpoon right through his body. The way he towed the water was beautiful, but we would not give him an inch of line, and he also had to succumb to a rather protracting lancing. His size will give you an idea of his strength in the water—forty-two feet in circumference! We got him awash on the beach, but the united strength of ten men could not haul him an inch further, so we were obliged to leave him there. By this time the sharks will not have left much of him; they have not had such a meal as that for a long time. The fishermen say that when alive the sharks don't molest the 'diable-de-mer,' whose offensive weapons consist of those enormous flexible sides (one can hardly call them fins), with which they can beat almost any shark to death. As a rule, when harpooned, they endeavour, like other rays, to bury themselves in the sand, and if they succeed in doing this, no line can ever haul them out of it—their flat bodies act on the principle of an enormous sucker. Another curious fact about them is that when harpooned they swim sideways, 'edge on,' in order to avoid exposing too broad a surface to their enemy. They never do this unless harpooned. By the way, please give me his scientific name—I suppose it is a *Trygon*. I should have said *her* name, for she was full of eggs. Altogether we made a pretty good bag. The men brought back 1,200 lbs. of salt fish of all sorts. We got twenty-three sharks, from three to five feet long; one demoiselle (*Galeocerdo tigrinus*, M. and H.) thirteen feet one and a half inches. Its jaws, which now ornament my dining-room, can be slipped over my shoulders without touching them on any side. Another demoiselle, ten feet long; one *Raye Fouet* (Creole), (*Trygon narrali*, Forster), seven feet nine inches in diameter, not including its tail, but accurately measured sideways; and, lastly, the diable-de-mer, forty-two feet in circumference."

SUB-CLASS V.—CYCLOSTOMATA.

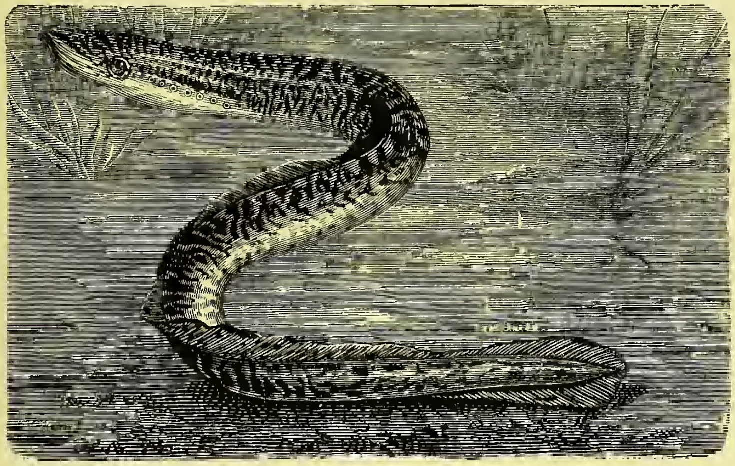
The few fishes belonging to this sub-class possess a cartilaginous skeleton, and the dorsal-cord (notochord) has not disappeared. They have no real jaws; their mouths are suctorial. They have none of the paired fins. Their gills are in the form of little fixed sacs, six or seven in number, on either side. They were included in a sub-order by Prince Bonaparte, called the Marsipobranchii, from the gills being included in little pouches, and we retain the name for the order.

ORDER XII.—MARSIPOBRANCHIATA.

This order contains the Lampreys and Glutinous Hags. The first of these form the family Petromyzonidæ, which contains a small number of eel-shaped naked fish, living in fresh water, and, strange to say, undergoing a metamorphosis, for Prof. Aug. Müller has shown that the larval form is that known, up to 1856, as an Ammocœtes. He has proved the truth of his discovery, by tracing the development of Ammocœtes branchialis into Petromyzon planeri. It may be assumed that not only the Petromyzons proper, but also the fishes of the allied genera, undergo a similar metamorphosis.

Ammocœtes branchialis requires three or four years for its complete development. In the larval state the head is very small, and the mouth cavity is surrounded by a semicircular upper lip, the separate lower lip being very small. There are no teeth, but several fringed barbels surround the mouth. The eyes are extremely small, hidden in a shallow groove. A medium single nasal opening and seven gill-openings exist, as in the adult. The vertical fins form a continuous fringe, in which the latter divisions are more or less distinctly indicated.

Of the species of Petromyzon, the following are British:—The Sea Lamprey (*P. marinus*) is widely dispersed in the seas of Europe, North America, and West Africa. Its colour is olive-brown, marbled with a dark green and dusky brown. It exists in the Mediterranean, as well as in the colder climates. It ascends the rivers in the spring or summer. Formerly great numbers worked their way up the Thames to a considerable distance, but few are now taken. In the Severn there is a periodical influx of these fishes in considerable numbers, during the months of April and May, and also in various rivers which open into the sea along our southern coast.



THE LAMPREY (*Petromyzon marinus*).

"In Scotland," says Sir W. Jardine, "they ascend the rivers to breed till about the end of June, and remain until the beginning of August.

The progressive motion of the Lamprey in the water is undulatory, like that of an eel, but from time to time it seeks to moor itself to any fixed object that offers, and then darts again onwards. Soft animal substances constitute its nutriment. It fixes on its prey like a leech. When full grown, this species attains to the length of twenty-five or twenty-six inches.

The lamprey has from early times been regarded as a delicacy for the table. The potted lampreys of Worcester are celebrated. Henry I., surnamed Beauclerc, says Rapin, was exceedingly regular in his diet, and "never known to be guilty of any excess in eating or drinking." So far his practice appears to have inculcated

> "The rule of 'not too much,' by temperance taught,
> In what thou eat'st and drink'st, seeking from thence
> Due nourishment, not gluttonous delight."

There seems, however, to have been one sad exception to his rule; for it is stated that his death was brought on by immoderately eating lampreys, of which he was very fond.

The River Lamprey (*Petromyzon fluviatilis*), a smaller species, of a bluish colour above, passing into white beneath, is a permanent resident in many of the English rivers, as well as those of Scotland and Ireland. It is about twelve or fourteen inches long. Formerly, this fish was taken in enormous quantities in the Thames, as many as one million, or ten hundred thousand, being captured in a single year. Numbers are sold to the Dutch fishermen as bait. Mr. Yarrell says that 400,000 have been sold in a single season, at the rate of forty shillings per thousand. At present the lamprey is far less plentiful in the Thames than formerly. In the Severn, the Dee, and the Mersey, as well as other rivers, it still abounds. This species breeds in May, and is in the best condition from October to March, during which period only its fishing is permitted.

The Pride (*P. branchialis*) is a third species, common in European and West North American rivers, which is interesting from the previously referred to investigations into its history by Professor Müller.

The second family of this order, that of the Myxinidæ, contains not more than half-a-dozen species of marine eel-like fish, whose mouths are provided with barbels. These fish have the strange habit of burrowing into other fishes, and living on their flesh. There is but one native species, the Glutinous Hag (*Myxine glutinosa*); it is often called the Borer, and is very often to be found in the body of the cod fish.

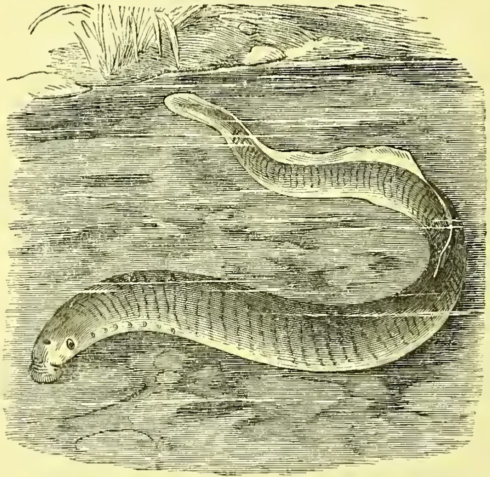
SUB-CLASS.—VI.—LEPTOCARDII.

This sub-class is formed for the reception of but one fish, and is the lowest of all living vertebrate animals. Its skeleton is quite cartilaginous and notochordal. In place of a heart, it has only a pulsating enlargement of a blood-vessel, in which circulates colourless blood. To preserve uniformity in our classification, we may form it into what will be the last order.

ORDER XIII.—CIRROSTOMI.

The opening which serves for a mouth to this fish leads to a large gill-sac, at the posterior end of which the alimentary canal opens. By the action of cilia lining this cavity, the water is carried around its walls, passing off through several slit-like openings into the general cavity of the body, from whence it escapes by one special opening.

The family Amphioxidæ contains the Lancelet (*Amphioxus lanceolatus*), which is a little fish, measuring from one to three inches in length, nearly transparent, and often slightly iridescent. It seems to be found on shallow sandy bottoms of the sea, where-ever looked for. I have taken it on the west and south-west of Ireland, and have found it equally common around the Seychelles Islands near the Equator in Indian Ocean. It was first described as a fish by Mr. Yarrell in 1836, from specimens taken at Polperro, on the beach, after a storm; but Pallas had previously described it as a slug.



PETROMYZON FLUVIATILIS.

SUB-KINGDOM II.—ARTHROPODA.

The sub-kingdom now generally established under the above name corresponds with the fifth class of Linnæus, which he called Insecta. The animals belonging to it have feelers (antennæ), and in this they differ from the creatures of the next class of Linnæus, the worms. From the sub-kingdom of the Vertebrates they differ profoundly. Linnæus tried to condense these differences into a sentence: "They, the insects, never had red blood." But, in addition to this fact, we now know that the four classes—Insects, Centipedes, Spiders, and Crabs—that we here place in the sub-kingdom containing animals with jointed limbs (Arthropoda), agree in this: that their bodies are divided into many segments; that the outer layer of these body segments is generally hardened; there is no internal skeleton; all or some of the segments are furnished with articulated limbs, and of these limbs a certain number are modified so as to act the part of foot-jaws. This sub-kingdom embraces a most enormous number of species; probably over 130,000 are known. Mr. Wallace hints at there being possibly 100,000 insects, and in addition there would be the immense groups of the Crustaceans and the Arachnids. Volumes have been and still will be written on the species forming this sub-kingdom. Kirby and Spence's famous "Introduction to the Study of Insects" is in four volumes, and Westwood's most valuable "Introduction to the Classification of Insects" is in two large volumes. In this volume we must content ourselves with but a few pages, and hence can but single out here and there some striking form to illustrate the classes and orders.

CLASS I.—INSECTA.

In this class the tegumentary system is well developed. It consists mostly of a horny substance, called chitine, which is a nitrogenous derivative from protoplasm; this will be sometimes dense and hard, as in the wing-cases of some beetles, sometimes much less so, as in the body of a flea. When this substance is well developed in the skin of the segments, these are joined together by an integument of a softer nature. This integument is often furnished with scales and hairs, and is supplied with minute glands. In the butterflies and moths, the often splendid colour of their wings and bodies is owing to the beautiful scales which cover those portions, and which are easily removed by a touch. In some insects the skin glands secrete a honey or a waxy substance; and in the bees, the wax which they form into the honeycombs is the product of a number of such glands. Sometimes these glands will secrete odoriferous particles, as in many of the bugs; and at other times some of them will give origin to a phosphorescent substance, which may, as in the glowworm, shine with an intermittent lustre; or, as in the Italian fire-fly (*Lucciola*), with a more or less steady flame.

In connection with the subject of these glands, it may be here mentioned that some insects possess spinning glands, whose function it is to spin silk. These glands are mostly developed in the larval condition of the insect.

Taking into our consideration any ordinary insect—say a bee—we can without difficulty divide its body into three well-marked portions: the head, the body, and the abdomen. The first will carry the special sense organs; the second the organs of locomotion; and the third will contain the reproductive organs, and is often furnished with appendages, forming weapons of offence (stings) and defence (as in earwigs), very rarely assisting in motion (as in the springtails).

It will be remembered that all these three portions of the body are made up of segments; these may be more or less closely united to one another. In the head we never find fewer than six, but these are so intimately united that we know of them only by the appendages that are present; such as the feelers (antennæ), the eyes, and the jaws. The antennæ vary much. Selecting some familiar examples, we find them very small in the house-fly; plumose in the gnat; long and knobbed in our common butterflies; beautifully feathered in some moths; long filaments in the cockroach, or black-beetle, and the cricket; forming folds, like the leaves of a book, in the cockchafer and rose-beetles; and of great size in the musk-beetles.

The organs of vision of insects, too, vary greatly. They are either mere eye-points (ocelli), which can be seen to form a little triangle behind the large eyes in a bee or wasp, or they form large eyes, composed of numerous six-sided facettes—so numerous that Leeuwenhoeck counted 8,000 in the eye of a fly, and Strauss 8,820 in that of a cockchafer. These so-called compound eyes are to be found on either side of an insect's forehead. The simple eyes vary in number; the compound eyes are never more than two. A few insects are entirely without eyes; these are chiefly found living in caves. Some have compound eyes and no simple eyes, as the butterflies and beetles; while some few have simple eyes only, as in the well-known flea (Pulex, also in Pediculus). The mouth in insects consists of six principal parts, which can be dissected out without much difficulty in a large beetle. Four of these parts are in pairs, and move in a to and fro direction, and the other two parts are placed facing each other, above and below; one of these latter forms the upper lip (labrum), and one the lower lip (labium). The labium is formed of two parts, one of which is superior (ligula) to the other (mentum). The four-paired portions constitute upper and lower jaws (mandibles and maxillæ); the former are often very hard and tear the food, while the latter are softer and convey the food to the gullet to be swallowed. While, however, this is the form of mouth to be met with in insects that masticate their food, the mouth in those insects which live by suction is different, and the parts above referred to are modified. In the moths and butterflies the lips and jaws are very feebly developed, while the tongue (ligula) is greatly developed, and is rolled up when at rest. In the flies the under lip forms the snout; in its interior are the sucker-like setæ. In the bugs the under lip forms the sheath, and the setæ are the altered upper jaws. In the flea the middle lancet seems to represent the upper lip itself.

The body consists of three pieces, each of which will bear one pair of feet. When the insect is four-winged, the front pair of wings is placed on the middle pair of these pieces, and the hind pair on the last of the three; and where they are two-winged, the wings are on the middle piece. The feet are always jointed. The joint nearest the body is called the hip (coxa); the second is the trochanter, often very short; then the thigh (femur), often the longest joint in the leg; next the shank (tibia), often flattened; and lastly, the foot (tarsus), consisting of a varying number of joints, but mostly five. The last foot-joint may end in two little claws, or, as in the common fly, the foot may be provided with little cushions, enabling it to walk on polished surfaces.

The wings in insects vary much in form and structure. They are usually membranous, but the membrane may be hard and dense, as in the front wings (elytra) in beetles; or gauze-like, as in the dragon-flies; or covered over with brilliantly-coloured scales, as in the butterflies; or half horny and half membranous, as in some of the bugs; or scarcely developed, as in the little hind-wings (halteres) in the fly; or wanting, as in the bug and flea, or as in the females of many insects.

The abdomen usually consists of nine segments, and as the sense organs are fixed in the head, the locomotory organs in the body, so here are placed the organs of alimentation and reproduction. The gullet often expands into a crop: next there will be a muscular or gizzard-like stomach; then a longish chyliferous stomach, around the inferior orifice of which a number of fine vessels are placed (malpighian vessels); there is next a small intestine, ending in a large one. Salivary glands, placed at the commencement of the alimentary canal, are often present.

The blood system is well represented in insects. The blood is sometimes colourless, sometimes it is of a greenish or reddish hue. The heart has the form of a long tube, and lies above the alimentary canal on the upper surface of the body. The respiration in insects is of a totally different type from that of Vertebrates. In insects, air canals (tracheæ) permeate through portions of the body, and communicate with the open air by means of small orifices (stigmata). These air canals have a middle coat, which consists of elastic threads rolled in a spiral manner, which gives to the canals a ringed appearance, and serves the purpose of keeping them always open. The larger canals end in smaller branches, and these again in some twigs of wonderful fineness. If dissected out under water they present a beautiful appearance, as the canals, being full of air, shine like quicksilver.

The number of stigmatic openings varies in the insects. There are ten pairs in the locust, but it is rare to find more than nine pairs. In Nepa there is but one pair. They are usually placed under the protection of the wings.

The nervous system in insects consists of a series of nervous masses (ganglia), connected the one to the other by means of two nervous threads, the whole constituting a nervous chain, which is placed beneath the intestinal canal of the insect. The first ganglion is above the gullet, the second ganglion is below it, and so the gullet runs through a nervous collar, formed by the threads connecting these two nerve masses (œsophageal collar). From the first ganglion proceed nerves to the feelers (antennæ) and to the eyes; from the second the mouth organs are supplied.

In insects the sexes are distinct, and they are often distinguished by their colour-marking, their size, and the shape of the antennæ. Leaving aside for the moment the very remarkable phenomenon of bud-like development, to be met with in some plant lice (*Aphides*), all insects proceed from eggs, from which are hatched out, either through the heat of the sun (as in moths, &c. &c.) or of the parent's body (blow-fly), the form so well known as caterpillar or maggot—a form totally unlike the parent which laid the egg, and which, only by a more or less slow change of form, known as metamorphosis, passes at last into a stage, known as the perfect stage, in which it is like that parent. This metamorphosis is effected thus:—The caterpillar (larva) having been hatched from the egg (ovum), commences to feed. This it does more or less voraciously; and it is noteworthy that the parent insect will lay its eggs either near a source of food—near green leaves, in meat, in furs or skins —or will store up food for the young larval form, as in the case of the honey-bee and many wasps and beetles. The caterpillar as it eats increases in size, and at each increase casts its skin, getting a new one. At its last moult it loses its limbs, acquires a hard, rigid skin, becomes quiescent, and then alters into a chrysalis (pupa) stage, from which it emerges in a perfect form (imago).

"Voyez ce papillon échappé du tombeau;
Sa mort fut un sommeil, et sa tombe un berceau."

Various forms of metamorphosis are to be met with in the different orders. During this metamorphosis changes take place, not only in the external form, but also in the internal structure of the insect. Thus there are differences to be met with in the alimentary and nervous systems of a caterpillar and a moth; and it will be remembered that while the former may be a greedy eater of green leaves the latter may be unable to feed on aught but the liquid nectar of flowers. The life of the perfect insect will vary much. In some beetles it is limited to a year, in others it extends to several; but in some insects life scarcely lasts through the afternoon of a summer's day.

The instincts of insects are most wonderful, and these have from a very early period attracted the attention of mankind. As the birds among the Vertebrates, so are the insects among the Invertebrates. They are most clever architects, constructing wondrous habitations, and taking often the greatest care of their eggs and young. In referring to the orders, we shall cull a few extracts relating to their cunning skill.

To mankind, insects are a source of much direct and indirect harm. Some of them are, as it were, our personal enemies, such as fleas, bed-bugs, lice, mosquitoes, and others. Some will fearlessly attack us if annoyed or disturbed, as bees, wasps, ants, &c. Some indirectly injure us by attacking our domestic animals, as the horse and ox-flies. But probably the greatest injuries to man are those inflicted upon the vegetable crops which form the staple of his food. Who has not heard of the ravages of the locusts?

> "And the locusts went up over all the land of Egypt, and rested in all the coasts of Egypt: very grievous were they; before them there were no such locusts as they, neither after them shall be such. For they covered the face of the whole earth, so that the land was darkened; and they did eat every herb of the land, and all the fruit of the trees which the hail had left: and there remained not any green thing in the trees, or in the herbs of the field, through all the land of Egypt" (Exodus x. 14, 15).

Our wheat, hops, and turnips, not to refer to our less important garden products, have all in times past suffered immensely from insect ravages.

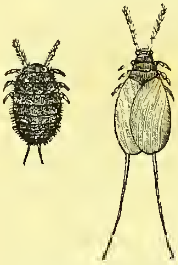
But on mankind insects also confer some direct benefits, and to them we are indebted for honey, wax, several dyes, and silk, and less directly, but still immensely, are we indebted to them as being the means of fertilising very many of the flowering plants.

As to the division of insects into orders, there is much difference of opinion. We will here content ourselves with dividing the class into six orders, arranged as follows:—

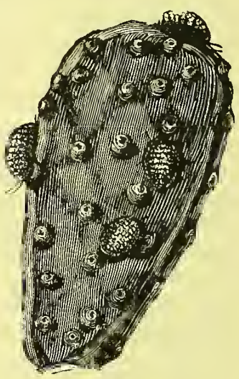
I. Hemiptera (1).
II. Neuroptera (6). | VI. Diptera (2).
III. Coleoptera (5). | V. Lepidoptera (3).
IV. Hymenoptera (4).

ORDER I.—HEMIPTERA.

THE insects belonging to this order are commonly provided with four wings, of which the front ones are more or less leathery at the base, and are so folded as to give them the appearance of being half wings, from whence the name of the order. In some species, however, the anterior wings are membranous, like the posterior. In some, as the bed-bugs, the wings are almost altogether absent. The mouth is, in some species of the order, fitted for suction, while in others the jaws are developed for the purposes of mastication. In some the metamorphosis is complete, at least, in one sex (*Coccus*); in others it is incomplete, that is, the pupa stage, instead of being one of absolute rest, is one in which the species can both move about and feed. Of the very numerous families we can only mention a few.



COCHINEAL INSECTS, MALE AND FEMALE. (*Magnified.*)



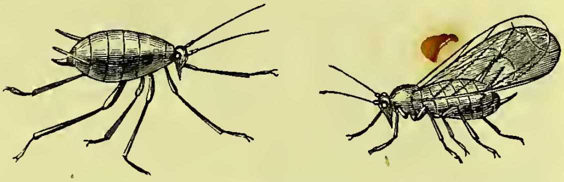
COCHINEAL INSECTS ON CACTUS.

That of the COCCIDÆ contains the well-known scale insects; while the males are winged the females are wingless. The Cochineal insect (*Coccus cacti*) is found in Mexico. It has been calculated that 70,000 dried insects are required to make one pound of cochineal, and over 800,000 pounds' weight of this substance is annually imported into Europe. The cochineal, writes Sir W. Wilde, is much propagated at Teneriffe upon the cacti; and, besides the several close plantations near the town, it has lately been transplanted to the plants growing on the hills, by enclosing one or two of the little animals in a bag of thin muslin, and sticking these on the thorns of the leaves. They were originally imported from South America ten years before the date of my visit (1838), and promise well. They are gathered every second year, a certain number being left on each plant to continue the stock. It is asserted in the island that it would be more cultivated but that the fruit of the cactus (the prickly pear) is a favourite article of food with the natives, and it falls off before coming to maturity on those on which the cochineal is reared. The *palma christi*, or castor-oil plant, is also very common here, and the oil is manufactured on the island. Another species, found in Bengal (*Coccus ficus*), yields shellac. Another species, known as the Coffee Bug (*Lecanium coffeæ*), commits vast havoc at the Ceylon coffee plantations. Dr. Gardner says:—The first thing that attracts attention on looking at a coffee-tree which has for some time been infected by this coccus, is the number of brownish wart-like bodies that stud the young shoots and occasionally the margins on the under side of the leaves. Each of these warts or scales is a transformed female, containing a large number of eggs, which are hatched within it.

When the young ones come out from their nest, they run about over the plant looking very much like diminutive wood-lice, and at this period there is no apparent distinction between male and female. Shortly after being hatched the males seek the under side of the leaves, while the females prefer the young shoots as a place of abode. If the under surface of a leaf be examined, it will be found to be studded, particularly on its basal half, with minute yellowish-white specks of an oblong form. These are the larvæ of the males undergoing transformation into pupæ, beneath their own skins. Some of these specks are always in a more advanced state than others, the full-grown ones being whitish and scarcely a line long.

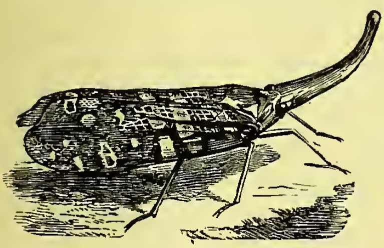
The female, like the male, attaches herself to the surface of the plant, the place selected being usually the young shoots; but she is also to be met with on the margins of the under sides of the leaves (on the upper surface neither the male nor the female ever attach themselves); but, unlike the male, which derives no nourishment from the juices of the tree (the mouth being obsolete in the perfect state), she punctures the cuticle with a proboscis (a very short three-jointed promuscis), springing as it were from the breast, but capable of being greatly porrected, and inserted in the cuticle of the plant, and through this she abstracts her nutriment. In the early pupa state the female is easily distinguishable from the male, by being more elliptical and much more convex. As she increases in size the skin distends and she becomes smooth and dry; the rings of the body become effaced; and losing entirely the form of an insect, she presents for some time a yellowish pustular shape, but ultimately assumes a roundish conical form, of a dark brown colour.

It is not till after this pest has been on an estate for two or three years that it shows itself to an alarming extent. During the first year a few only of the ripe scales are seen scattered over the bushes, generally on the younger shoots; but that year's crop does not suffer much, and the appearance of the tree is little altered. The second year, however, brings a change for the worse. If the young shoots and the under side of the leaves be now examined, the scales will be found to have become much more numerous, and with them appear a multitude of white specks, which are the young scales in a more or less forward state. The clusters of berries now assume a black, sooty look, and a great number of them fall off before coming to maturity; the general health of the tree also begins to fail, and it acquires a blighted appearance. A loss of crop is this year sustained, but to no great extent.

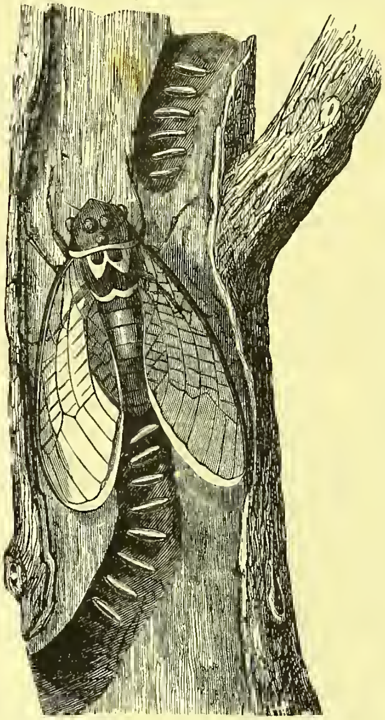

WINGED AND WINGLESS APHIDES (*Phorodon humuli*).

The third year brings about a more serious change. The whole plant acquires a black hue, appearing as if soot had been thrown over it in great quantities. This is caused by the growth of a parasitic fungus over the shoots and the upper surface of the leaves, forming a fibrous coating, somewhat resembling velvet or felt. This never makes its appearance till the insect has been a long time on the bush, and it probably owes its existence there to an unhealthy condition of the juices of the leaf, consequent on the irritation produced by the coccus, since it never visits the upper surface of the leaf until it has fully established itself on the lower. At this period the young shoots have an exceedingly disgusting look, from the dense mass of yellow pustular bodies forming on them; the leaves get shrivelled, and the trees become conspicuous in the row. The black ants are assiduous in their visits to them. Two-thirds of the crop is lost, and on many trees not a single berry forms.

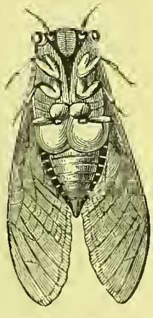
The Plant Lice constitute the family of APHIDÆ. They live on different parts of plants in vast numbers, sucking their juices, as every grower of a rose-bush or a geranium plant must know. Most wonderful to relate, these Aphides can increase to two or three generations by means of a budding process, which does away with the necessity of even an incomplete metamorphosis. Phorodon humuli is the dreaded hop fly.


THE SMALL LANTERN FLY.

The Lantern Flies (FULGORIDÆ) form a widely-diffused family. One species (*Fulgora laternaria*) is from Surinam, and another (*F. candelaria*) is common in China. Both are said to be phosphorescent. Kirby and Spence tell us that both (as indeed is the case with the whole genus), are supposed to have the material which diffuses their light included in a sub-transparent projection of the head. In F. candelaria this projection is of a sub-cylindrical shape, recurved at the apex, above an inch in length, and the thickness of a small quill. In F. laternaria, which is an insect two or three inches long, the snout is much larger and broader, and more of an oval shape, and sheds a light the brilliancy of which is said to transcend that of any other luminous insect. Madame Merian informs us that the first discovery which she made of this property caused her no small alarm. The Indians had brought her several of these insects, which by daylight exhibited no extraordinary appearance, and she enclosed them in a box until she should have an opportunity of drawing them, placing it upon a table in her lodging-room. In the middle of the night the confined insects made such a noise as to awake her, and she opened the box, the inside of which to her great astonishment appeared all in a blaze; and in her fright letting it fall, she was not less surprised to see each of the insects apparently on fire. She soon, however, divined the cause of this unexpected phenomenon, and re-enclosed her brilliant guests in their place of confinement. She adds that the light of one of these Fulgoræ is sufficiently bright to read a newspaper by; and though the tale of her having drawn one of these insects by its own light is without foundation, she doubtless might have made the attempt if she had chosen.



FEMALE CICADA DEPOSITING HER EGGS.



MUSICAL APPARATUS OF MALE CICADA.

On the other hand, M. Lacordaire states that though he never saw a luminous individual of this species either in Brazil or Cayenne, and though the majority of the inhabitants of the latter country whom he questioned on the subject equally denied its being luminous, yet that others asserted the fact; and as he himself, a cautious observer on the spot, asks if this contradictory testimony may not be reconciled by supposing that one of the sexes is luminous and the other not, it seems clearly best to infer, with this acute entomologist, that the luminosity of Fulgora laternaria is a point rather requiring new observations than yet absolutely decided either way, especially when we find the Marquis Spinola, in his elaborate paper on this tribe in the "Ann. Soc. Ent. de France" (viii., 163), strongly contending for the luminous character of the cephalic protuberance of the whole tribe, and when, moreover, a friend of M. Wesmael assured him that he had himself seen F. laternaria luminous when alive.

The species of CICADIDÆ are found in warm countries. One of the best known (*Cicada orni*) was a favourite of the ancient Greeks, and its merits have been sung in an Anacreontic ode. They were called by the ancient Greeks—by whom they were often kept in cages for the sake of their song—Tettix; and they seem to have been the favourite of every Grecian bard from Homer and Hesiod to Anacreon and Theocritus. Supposed to be perfectly harmless, and to live only upon the dew, they were addressed by the most endearing epithets, and were regarded as all but divine. One bard entreats the shepherds to spare the innoxious Tettix, that nightingale of the Nymphs, and to make those mischievous birds the thrush and blackbird their prey. "Sweet prophet of the summer," says Anacreon, addressing this insect, "the Muses love thee; Phœbus himself loves thee, and has given thee a shrill song; old age does not wear thee out; thou art wise, earth-born, musical, impassive, without blood; thou art almost like a god." So attached were the Athenians to these insects, that they were accustomed to fasten golden images of them in their hair, implying at the same time a boast that they themselves, as well as the Cicadæ, were Terræ filii. They were regarded, indeed, by all as the happiest as well as the most innocent of animals—not, we will suppose, for the reason given by the saucy Rhodian Xenarchus, when he says—

> "Happy the Cicadas' lives,
> Since they all have voiceless wives."

If the Grecian Tettix or Cicada had been distinguished by a harsh and deafening note, like those of some other countries, it would hardly have been an object of affection. That it was not, is clearly proved by the connection which was supposed to exist between it and music. Thus, the sound of this insect and of the harp were called by one and the same name. A Cicada sitting upon a harp was a usual emblem of the science of music, which was thus accounted for:—When two rival musicians, Eunomus and Ariston, were contending upon that instrument, a Cicada flying to the former and sitting upon his instrument supplied the place of a broken string, and so secured to him the victory. To excel this animal in singing seems to have been the highest commendation of a singer; and even the eloquence of Plato was not thought to suffer by a comparison with it. At Surinam the noise of the Cicada tibicen is still supposed so much to resemble the sound of a harp or lyre, that they are called there harpers. Whether the Grecian Cicadæ maintain at present their ancient character for music, travellers do not tell us.

(1) RANATRA LINEARIS; (2) NOTONECTA GLAUCA; (3) NEPA CINEREA.

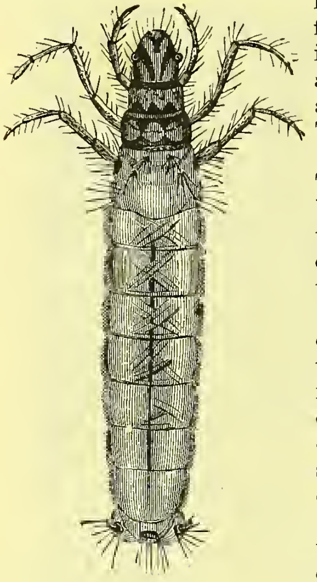
Those of other countries, however, have been held in less estimation for their powers of song; or rather have been execrated for the deafening din that they produce. Virgil accuses those of Italy of bursting the very shrubs with their noise; and Sir J. E. Smith observes that this species, which is very common, makes a most disagreeable dull chirping.

BED BUG (*Acanthia lectuarius.*)

The Water Bugs and Water Boatmen (Nepidæ and Notonectidæ) also belong to this order, and lead us to the Tree Bugs (Cimicidæ), of which some of the tropical species are most brilliantly coloured, and of which one species at least has almost lost its wings, and prefers human blood to any vegetable juices. This species (*Acanthia lectuarius*) is too well known to need description. It can live for an immense length of time without food. It is not killed by the severest cold, is fond of living in beds, and is the very reverse of a pleasant bed-fellow. Mouffet mentions (1503) that two noble ladies were thrown into a great fright by the appearance of bug bites upon them. They thought they had caught the plague. Fortunately their physician was an entomologist, and soon dispelled their fears. The bug was probably introduced in England by commerce about this date. The original English name was wall louse. The term bug seems to be of Celtic origin, and to signify a ghost.

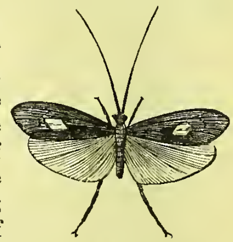
ORDER II.—NEUROPTERA.

The insects belonging to this order have mostly four wings, which are transparent, membranous, often equal in size. In most the mouth is formed for mastication; the metamorphosis is incomplete. The order receives its name from the well-marked nervures (neuron) on the wings. We include in the order the Orthoptera—the members of which are mostly terrestrial, whereas the more typical Neuroptera are rapid flyers—and the little groups of Trichoptera and Thysanoptera.


LARVA OF PHRYGANEA RHOMBICA.

The Caddis Flies (Phryganidæ) are well-known forms. The larvæ live in water, and form beautiful cases round their bodies of bits of twigs, moss, or shells. They are well known to the angler, and the perfect insects, often in summer evenings allured by the light of our lamps, flutter around the flame until they are destroyed.

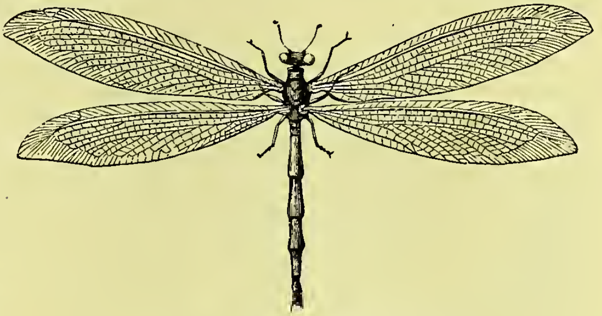
Placing yourself by the side of a clear and shallow piece of water, you may be able to observe at the bottom little oblong, moving masses, resembling pieces of straw, wood, or even stone—the residences of a species of caterpillar. Very various is the structure of these dwellings. Some caterpillars select four or five pieces of the leaves of grass, which they glue together into a shapely polygonal case; others employ portions of the stems of rushes placed side by side, so as to form an elegant fluted cylinder; some arrange round them pieces of leaves, like a spirally-rolled riband; other species construct houses which may be called alive, forming them of the shells of various aquatic snails of different kinds and sizes, even while inhabited, all of which are immovably fixed to it, and dragged along at pleasure. However various may be the form of the case externally, within it is usually cylindrical and lined with silk. But, watch as you may, of the inmate of any one you will see nothing except the head and six legs, by means of which it moves itself in the water, and drags after it the case in which the rest of the body is enclosed, and into which, on any alarm, it instinctively retires. Phryganea rhombica, which we figure, is a well-known species.


PHRYGANEA RHOMBICA.

In the basin of the Allier, in Central France, the lower strata consist of a calcareous sandstone, with bouldered pebbles and primitive fragments imbedded in it. There are also many beds of white, marly limestone, consisting of an amazing aggregate of the dwellings of these very caterpillars. These are quitted when the insect's metamorphosis is completed; and on the banks of rivers or marshes frequented by them you may find groups of such empty cases, arranged much in the same manner as those we are now considering appear to have been when the calcareous matter incrusted them. Some are immediately surrounded and cemented together by the stalactitic substance—others by innumerable multitudes of casts of minute shells, arranged with some symmetry round each tube, and pressing closely on one another. More than a hundred of these shells may be counted on each tube, and ten or twelve tubes are constantly packed together within the space of a cubic inch. If, then, we consider that repeated strata, averaging five or six feet in thickness, and almost entirely composed of these tubes, appear once to have extended over the whole plain, occupying a surface of many hundred square miles, we shall arrive at an imperfect idea of the countless myriads of minute beings belonging to a single species of insect, which have lived and died in turn within the bosom of this once extensive lake.

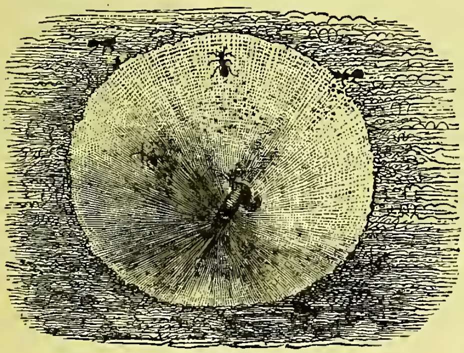
CASE OF A PHRYGANEA.

The family Hemerobidæ contains one beautiful native insect (*Hemerobius perla*), which has broad, delicately-latticed wings that glisten with prismatic colours, and its eyes shine like gold. Here also belong the Ant-Lion (*Myrmeleon formicarum*). This, in its perfect stage of existence, is a four-winged insect, resembling the dragon-fly both in appearance and general habits, preying in like manner on other insects, being one of the falcons of its race. It is not, however, to the perfect insect that we are now about to call the attention of our readers, but to the larva, or insect in its imperfect state of being, before it has undergone its final metamorphosis.



THE ANT-LION (*Myrmeleon formicarum.*)

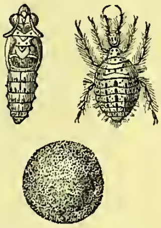
The habits and instincts of the larva of the ant-lion are so remarkable, that were they not attested by the most scientific entomologists we should almost hesitate to give credit to the account. Without wings, on which to cleave the air, and not only slow in its motions on the ground, but capable only of walking backwards, yet, at the same time, endowed with the ferocious appetite of a tiger, which propels it to a life of rapine, it may be asked, can it ever seize its prey? How can it exercise its carnivorous instinct, thus ill adapted as a hunter for the chase? It effects by the most astonishing artifice what it could not do openly: it digs a pitfall in which to take its victim, as the savage contrives to take the wild beast of the forest, the elephant or the rhinoceros.



THE ANT-LION'S TRAP.

The ant-lion, in its larva state, feeds on the blood or juices of insects, but especially of ants, whence it derives its name; and, in order to their capture, it digs a conical pit in fine loose sand, concealing itself at the bottom, so as to be ready to seize with its formidable jaws the unfortunate captive, who, approaching the margin, is sure to slide down the sides of the pit, the sand giving way beneath its feet.

The curious process by which the ant-lion excavates its trap is thus described by Kirby:—"Its first concern is to find a soil of loose dry sand—in the neighbourhood of which, indeed, its provident mother has previously taken care to place it—and in a sheltered spot, near an old wall or at the foot of a tree. This is necessary on two accounts: the prey most acceptable to it abounds there, and no other soil would suit for the convenience of its snare. Its next step is to trace in the sand a circle, which, like the furrow with which Romulus marked out the limits of his new city, is to determine the extent of its future abode. This being done, it proceeds to excavate the cavity by throwing out the sand in a mode not less singular than effective. Placing itself in the inside of the circle which it has traced, it thrusts the hind part of its body under the sand, and with one of its fore-legs, serving as a shovel, it charges its flat and square head with a load, which it immediately throws over the outside of the circle, with a jerk strong enough to carry it to the distance of several inches. This little manœuvre is executed with surprising promptness and address. A gardener does not operate so quickly or so well with his spade and his foot as the ant-lion with its head and leg. Walking backwards, and constantly repeating the process, it soon arrives at the part of the circle from which it sets out. It then traces a new one, excavates another furrow, and, by a repetition of these operations, at length arrives at the centre of its cavity. One circum-



LARVA, COCOON, AND PUPA OF THE ANT-LION.

stance deserves remark: that it never loads its head with the sand lying on the outside of the circle, though it would be as easy to do this with the outward leg as to remove the sand within the circle by the inner leg. But it knows that the sand in the interior of the circle only is that to be excavated, and it therefore constantly uses the leg next the centre. In order, however, that one leg may not do all the work, and so become unduly fatigued, it uses each alternately, by tracing each furrow in an opposite direction: that is, by going from right to left one circle and from left to right the next. Should it meet with small stones or pebbles in the progress of its labours, it jerks them, if not too large, over the margin of the pit; but, if it meet with one too heavy for this mode, it contrives to get it on its back, and, with painful labour, commences its backward ascent up the inclined and slippery embankment of the pit. Often does it fail, and often does it renew its labour, undaunted by disappointment, till at last its efforts are successful.

"The pit, when completed, is about two inches deep and three inches wide at the top, whence it gradually diminishes to the bottom, so as to form a conical hole in the sand. Here, then, in expectation of his prey, lurks the ant-lion at the bottom of his trap, carefully covered over with fine sand, so that no part, except the points of his expanded forceps, is visible. He has not long to wait; the ants are swarming around, and one of them presently makes its appearance at the margin of the pit, when, lo! the sand gives way, and down it slides into the jaws of the grim destroyer. Should it, however, be able to stop itself, as sometimes happens, before it reaches the bottom, it endeavours to re-ascend, being fully aware of its danger, but in vain. The eyes of the treacherous foe are upon it, and rousing himself in a moment, he throws a shower of sand upon the struggling captive, which, overwhelming it at once, inevitably brings it within his reach. And now begins the feast. His jaws, which are formidable claw-like instruments, are also hollow, and 'furnished with a lateral piston' for sucking up all the juices of the body. These he drives into the body of his prey, and gluts himself on the blood, leaving the carcase dry and shrivelled. This he afterwards jerks out of his den, and, covering himself as before, grimly waits for another victim. Thus for nearly two years does the ant-lion lead a life of artful rapine, feeding upon such insects as chance brings within his grasp."

When the ant-lion is about to change into a pupa, it constructs a cocoon of sand, which it lines with a beautiful tapestry of silk, the whole being less than half an inch in diameter; the pupa itself, when rolled up, filling only a space of about half this size. When it has remained in the cocoon about three weeks, it breaks through the envelope and emerges to the outside, the creature making use of its mandibles, or jaws, to gnaw open the cocoon. Having arrived at the outside, it only requires to expand its wings and its body to complete its transformation. But this process is very amazing; for though, on emerging, the creature is not more than half an inch in length, it almost instantaneously stretches out to an inch and a quarter; while its wings, which did not exceed the sixth of an inch, expand to nearly three inches.

The family of the ACHETIDÆ contains that well-known form the Cricket (*Acheta domestica*). This insect is found throughout Europe; it frequents houses, and prefers the vicinity of fires. The address of the poet to this creature is very pleasing:—

"Little inmate, full of mirth,
Chirping on my kitchen hearth,
Wheresoe'er be thine abode,
Always harbinger of good,
Pay me for thy warm retreat
With a song more soft and sweet;
In return thou shalt receive
Such a strain as I can give.

"Thus thy praise shall be express'd,
Inoffensive, welcome guest!
While the rat is on the scout,
And the mouse with curious snout,
With what vermin else infest
Every dish, and spoil the best;
Frisking thus before the fire,
Thou hast all thy heart's desire.

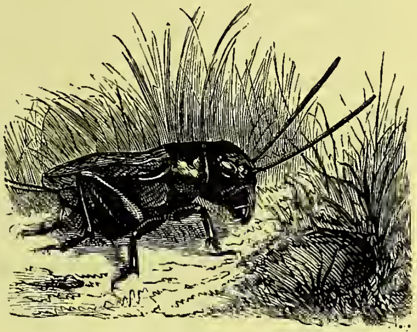
"Though in voice and shape they be
Form'd as if akin to thee,
Thou surpassest, happier far,
Happiest grasshoppers that are;
Theirs is but a summer's song,
Thine endures the winter long,
Unimpair'd, and shrill, and clear,
Melody throughout the year."

The celebrated naturalists, Linnæus and Bonnet, were disposed to consider insects as deaf; but the knowledge of Shakespeare was more accurate when he made Mamilius say:—

"I will tell it softly,
Yon crickets shall not hear it."

As soon as it becomes dark the chirping of crickets increases, and they come running forth, often in great numbers, from the size of a flea to that of their full stature.

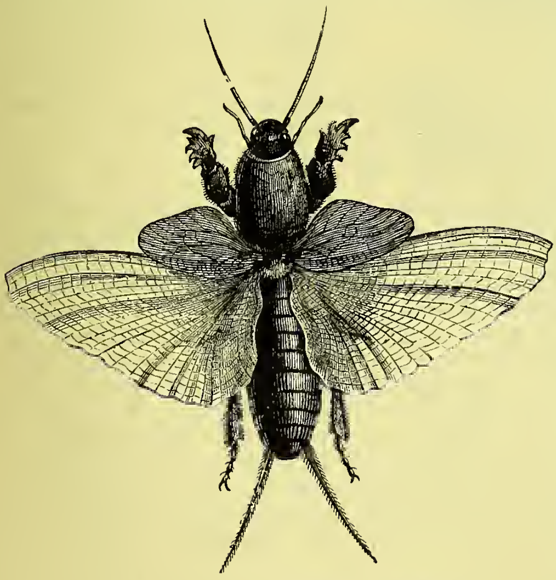
The instrument on which the male plays consists of strong nervures, or rough strings in the wing-cases, by the friction of which against each other a sound is produced and communicated to the membranes stretched between them, in the same way that the finger produces vibrations on a tambourine, which are then diffused over its surface.



THE FIELD CRICKET (*Gryllus campestris*).

To most people the chirp of the cricket conveys to the mind the idea of a perfectly happy being. Thus, to the Prince's question, "Shall we be merry?" Poins answers, "As merry as crickets." The learned Sçaliger took such a fancy to their song that he was accustomed to keep them in a box in his study. Osbeck states that the Spaniards confine some insects of an allied genus in cages for the sake of their song; and in some parts of Africa, it is said, the common house crickets are kept and fed in a kind of iron box, and sold to the natives, who like their chirp, and consider it a great soporific.

On one occasion, according to Southey, the song of an insect of this genus was the means of saving a vessel from shipwreck. The incident occurred in the voyage of Cabeza de Vara towards Brazil:—" When they had crossed the Line, the state of the water was inquired into, and it was found that of a hundred casks there remained but three to supply four hundred men and thirty horses. Upon this, the Adelantado gave orders to make the nearest land. Three days they stood towards it. A soldier, who set out in ill-health, had brought a grillo, or ground cricket, with him from Cadiz, thinking to be amused by the insect's voice; but it had been silent the whole way, to his no little disappointment. Now, on the fourth morning, the grillo began to sing its shrill rattle, scenting, as was immediately supposed, the land. Such was the miserable watch that had been kept, that upon looking out at the warning they perceived high rocks within bow-shot, against which, if it had not been for the insect, they must inevitably have been lost. They had just time to drop anchor. From hence they coasted along, the grillo singing every night as if it had been on shore, till they reached the island of St. Catalina."



THE MOLE CRICKET (*Gryllotalpa vulgaris*).

Like many noisy persons, crickets like to hear nobody louder than themselves. It is related that a woman, who had tried in vain every method she could think of to banish them from her house, at last got rid of them by the noise made by drums and trumpets, which she had procured to entertain her guests at a wedding. They instantly forsook the house, and she heard of them no more.

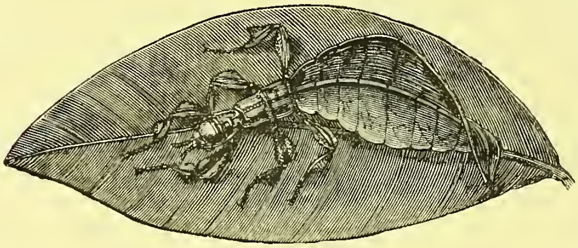
The Mole Cricket (*Gryllotalpa vulgaris*) lives underground, and only emerges into the open air at rare intervals, chiefly at night, and during dry weather. Its abode consists of a certain number of galleries, which diverge irregularly from a central cavity, communicating with the outside by a small aperture. These galleries are smooth in their interior, and are about a quarter of an inch in diameter. It is in the central cavity that the mo cricket retires, and remains immovable during the entire winter; it is also there whe the female lays its eggs.

The laying takes place in the spring, when the male chirps somewhat like the commo cricket, but not so piercingly. The young ones are white; gradually, however, they becom brown, and assume their natural colour, from which period their resemblance to the adult is complete, differing only from them by the absence of wings.

Around the central point of the abode of a mole cricket the earth is generally mor heaped up than in the more distant points; so that the presence of a nest may easily b known by an earth-heap, which stands out from the surrounding soil.

The galleries and the central cavity are not very deep; they scarcely exceed the extremity of the roots of kitchen-garden plants of small dimensions. In some instances, however, they have been found as deep as eighteen inches. The galleries are generally less deep than the cavity at the centre; they are even frequently known on the surface of the soil, by small longitudinal elevations of earth, which follow their direction.

The mole cricket digs itself these various subterranean spaces, making use of its fore legs, admirably adapted to the purpose. Somewhat like the mole, it cuts through the earth by throwing it aside, and partly raising it, by causing the small superficial elevations to which allusion has been made. It accomplishes its purpose notwithstanding often formidable obstacles.



A WALKING LEAF (*Phyllium siccifolium*).

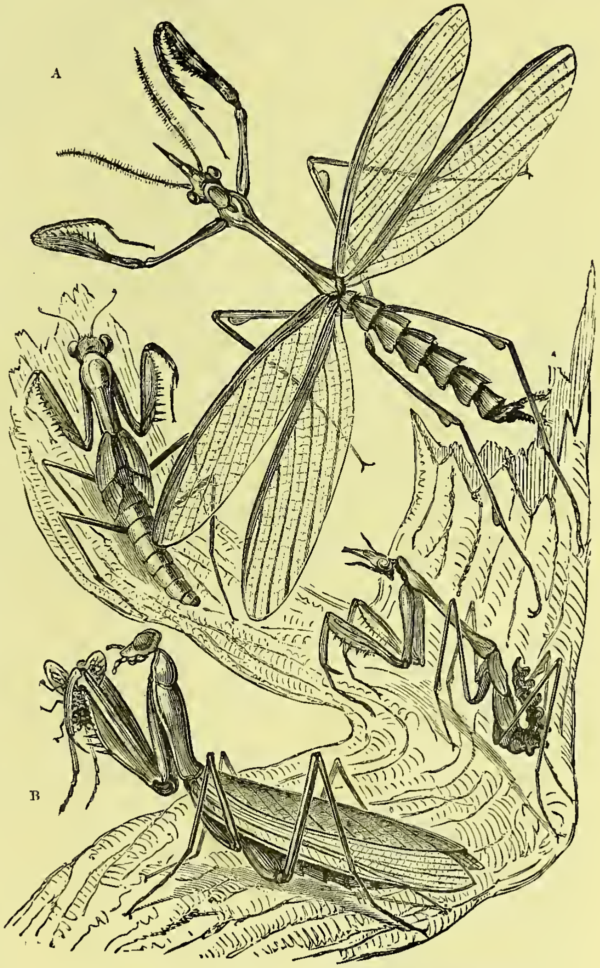
The strange forms belonging to the MANTIDÆ obtain for them the names of Leaves, Spectres, Straws, and Walking-sticks; and certainly nothing can be imagined more curious than the forms these insects assume. Thus, some appear like walking leaves, and others might be mistaken for a portion of the branches of the trees on which they rest.

"I have," says Mr. Kirby, "one of the spectre tribe from Brazil, eight inches long; and unless it was seen to move, it could scarcely be conceived to be anything but a small branch with its spray: the legs, as well as the head, having their little snags and knobs, so that no imitation can be more accurate.

A very surprising instance of the adaptation of the colour of some insects to that of the soil where they reside is found in some of the Mantis tribe. M. Lefevre met with these insects, in the pupa state only, in the very midst of the African desert, leading to the oasis of Bahryah, about four days' journey from the Nile, where he could not discover the slightest trace of any other insect or substance on which they could by possibility feed, but apparently passing a life of absolute solitude in the midst of these burning sands. They had the most perfect identity of colour with that of the soil on which they were found, being brown where the soil was brown, and, at not above a hundred paces distant, of a silvery white when found amongst the white particles of broken shells or calcareous rocks of a similar dazzling colour. That it was the same species which exhibited this change of colour M. Lefevre did not doubt; nor that the object was its protection from its enemies, which it was so well calculated to effect that he could scarcely detect it by the closest inspection; but he confesses himself unable to explain whether the different coloured insects were confined to the soils of the same tints respectively, or, as in the case of the birds and quadrupeds which become white in winter in the Polar regions, they had the faculty of changing their colour as they change their abode.

Here also belongs a very typical insect, the Praying Mantis (*Mantis religiosa*). The singular form, and particularly the attitudes of this insect, have given rise to several superstitions. "They are called mantes, that is, fortune-tellers," says Moffet, "either because by their coming (for they first of all appear) they do show the spring to be at hand, so Anacreon, the poet, sang; or else they foretell death and famine, as Cælius, the scholiast of Theocritus, writes; or lastly, because it always holds up its fore feet like hands, praying, as it were, after the manner of their diviners, who, in that gesture, did pour out their supplications to their gods. So divine a creature is this esteemed, that if the child ask the way to such a place, she will stretch out her feet and show him the right way, and seldom or never miss. As she resembleth those diviners in the elevation of her hands, so also in likeness of motion; for they do not sport themselves as others do, nor leap, nor play, but walking softly, she retains her modesty, and showes forth a kind of mature gravity."

The attitude, however, which has obtained for the insect the name of Praying Mantis (*Prie Dieu*, in France) is nothing more than the posture in which it patiently lies in wait for its prey; for having once set its eyes on an insect, it rarely loses sight of it, though it may require some hours before it can make a capture. Should the creature be overhead and beyond its reach, it slowly erects its long neck, and elevates itself on its hind legs. If this bring it within reach, it throws open the last joint of its fore paws and snaps the insect between the spines, set in rows on the second joint. Should it prove unsuccessful, it does not retract its paws, but holds them stretched out, and waits again till the insect is within its reach, when it springs up and seizes it. Should the insect go far from the spot, it flies or crawls after it slowly on the ground, like a cat, and when the insect stops it erects itself as before.



MANTIS RELIGIOSA AND ITS LARVA (A); BELPHARIS MENDICA AND ITS LARVA (B.)

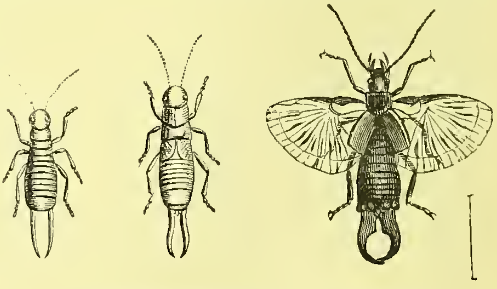
These creatures may be described as cannibal insects; and they show their savage habits in the earliest stage of their existence. Their eggs are placed in an oblong bag, of a thick, spongy, imbricated substance, and fastened lengthwise to the branch of a plant. Roesel, being desirous of observing the development of these insects, placed one of these egg-bags in a close glass, into which, when the young appeared, he put different sorts of plants. But vegetable food not suiting their tastes, they preyed upon one another. This determined him to supply them with insect food, and he accordingly put several ants into the nurse-glass. Then, however, they betrayed as much cowardice as they had previously showed barbarity; for the instant the ants were observed, the mantis attempted to escape in every direction, evidently from instinctive fear of a natural enemy. Afterwards he tried them with some of the common house-flies, and these they seized with eagerness and tore to pieces. But notwithstanding their apparent fondness for flies, they continued to destroy each other through savage wantonness. Roesel, despairing at last, from their daily decrease, of rearing any to the winged state, separated them into small parcels, in different glasses; but here, as before, the strongest of each community destroyed the rest.

The fore legs of these insects resemble somewhat a sabre in form; and they can as dexterously cleave their antagonist in two, or cut off his head at a stroke, as the most expert Life Guardsman. In this way they often treat each other, even the sexes fighting with the most savage animosity. M. Poiret put a male and female mantis into a glass, when the female instantly made an attack on her companion, seized him between the sharp points of her claws, and with these she soon cut off his head. As these insects are very tenacious of life, he appeared to continue lively for a considerable time; but the female ended by devouring him.

THE COCKROACH (*Blatta orientalis*).

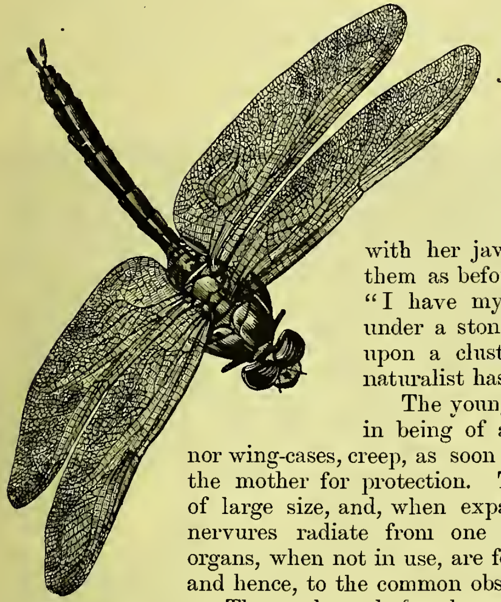
The Cockroaches form a family to themselves (Blattidæ). In London, and many other parts of the country, Cockroaches (*Blatta orientalis*) have multiplied so prodigiously as to be a very great nuisance. So numerous have they been in kitchens and other lower rooms in the metropolis as literally to cover the floor, and render it impossible for them to move except over each other's bodies. This, indeed, happens only after dark, for these are strictly night-insects, and the instant a candle disturbs them they rush towards their hiding-places, and in a few seconds not one of the countless multitude is to be seen. In consequence of their numbers, independently of their carnivorous propensities, they eat everything which comes in their way; and, besides devouring every species of kitchen-stuff, they gnaw clothes, leather, and books.

A recent writer says:—"Although cockroaches abounded inconveniently at the Mauritius, it was not without pity that I saw them consigned, as they frequently were, to a living grave by a wicked-looking insect [*Ampulex compressum*, a sand wasp]. It was impossible to witness his proceedings, combined with his glittering blue and green dress, without imagining the elfish demon of a pantomime leading an innocent victim to a perpetual entombment in a haunted cavern. Let the cockroach be moving never so briskly across the wall, he has no sooner caught sight of the fated insect—not a quarter his size—than all energy leaves him, and he stands stupidly resigned. The insect then walks up to him, looks him hard in the face, and presently, putting forth some apparatus, which stands him in place of a finger and thumb, gently takes the cockroach by the nose, and leads him daintily along for a foot or two. Leaving him there, he commences a thorough examination of the neighbourhood, beating the ground up and down like a well-trained setter, and, not finding what he wants, returns to the cockroach and leads him on a little further, when the same process is gone through, sometimes for hours, until the whole wall has been examined. Chinks there are in plenty, but they do not suit him. He has taken the measure of the victim's bulk, and means to lodge him commodiously. Presently a suitable hole is found, and the insect, moving backward, gently pulls the cockroach after him into his last home. What horrors are perpetrated in this dark recess cannot be more than surmised. The object, undoubtedly, is to engage him as a wet nurse. No doubt the poor cockroach is bored in some part not vital, and eggs laid in him, a purpose, indeed, for which his succulent and motherly frame seems peculiarly adapted. And, not improbably, during this vicarious incubation, he is supplied with food, until the young of whom he is pregnant being hatched, commence, in return for his services, to 'gnaw his bowels, their repast.' It is in vain that, during the scene above described, you urge the cockroach to seek safety by flight. The poke of a stick is disregarded. He seems dead to all hints; nay, move him to another part of the wall, he awaits


THE EARWIG—LARVA, PUPA, AND IMAGO.

there, with the same stolid indifference, the return of his tormenter. Probably a sly thrust is given him in the first meeting of noses, or some 'leprous distilment' dropped into his ear, for he has entirely the air of being hocussed."

The Earwigs (FORFICULIDÆ) must also be here alluded to. They appear to prefer damp situations, and are found under stones and the bark of trees, frequently in abundance. The female of our common species (*Forficula auricularia*) sits on her eggs in the manner of a hen, a fact which Frisch appears first to have noticed. De Geer having found an earwig thus occupied, removed her into a box where there was some earth, and scattered the eggs in all directions. She soon, however, collected them one by one with her jaws, into a heap, and assiduously sat upon them as before. "This remarkable fact," says Kirby, "I have myself witnessed, having found an earwig under a stone which I accidentally turned over, sitting upon a cluster of young ones, just as this celebrated naturalist has described."

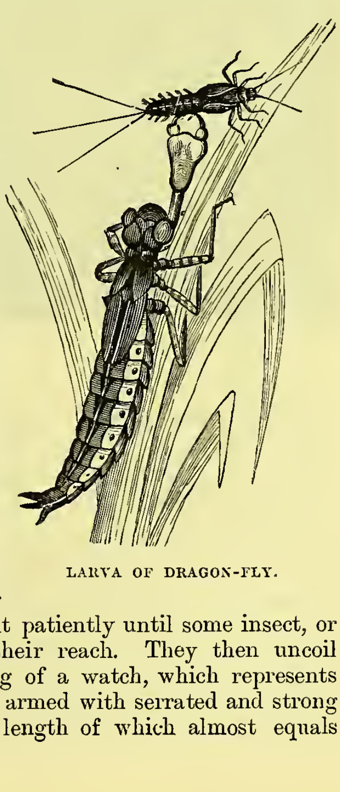

A DRAGON-FLY (*Libellula grandis*).

The young ones, which resemble the parent, except in being of a paler colour, and having neither wings nor wing-cases, creep, as soon as they are hatched, under the body of the mother for protection. The wings of the earwig are transparent, of large size, and, when expanded, shaded like a fan. The principal nervures radiate from one point near the anterior margin. These organs, when not in use, are folded beneath two small horny wing-cases, and hence, to the common observer, the insect appears wingless.

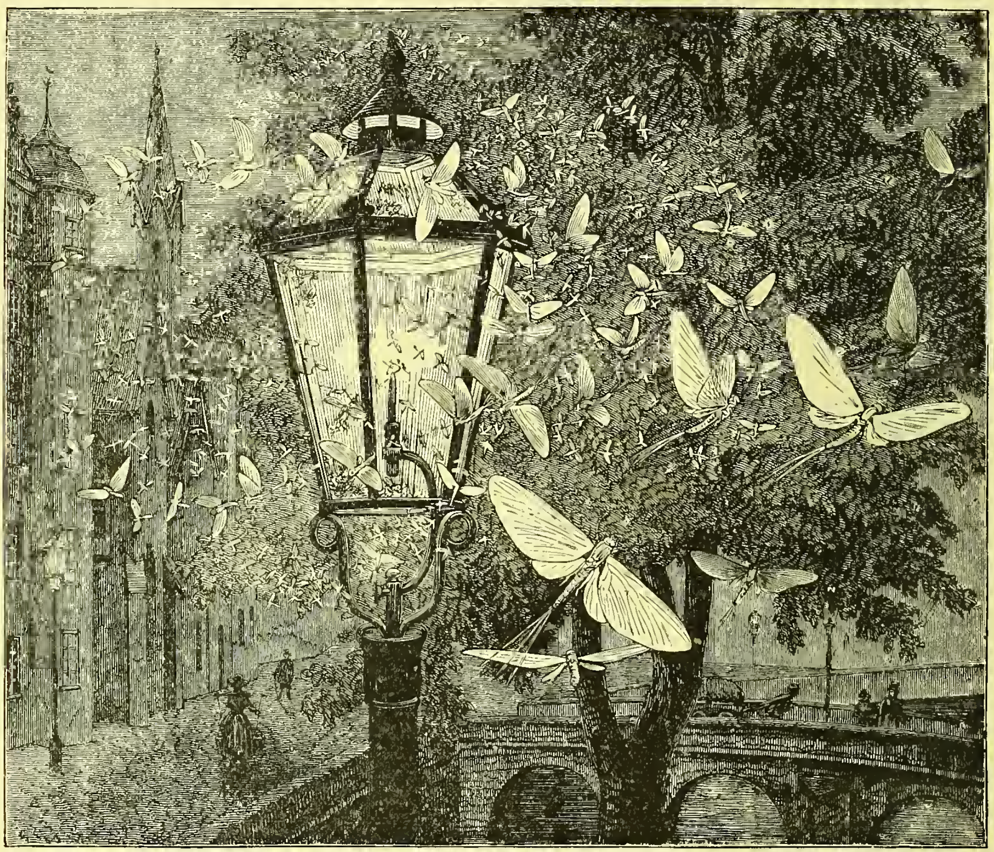
The male and female earwig differ considerably in their tail forceps; those of the female being less curved, and destitute of a tooth-like process, which is observed on the inner side at the base of the forceps of the male.

We may remark, in passing, that it is an unfounded popular prejudice that earwigs get into the brain by creeping into the ear; for though, from being night insects, and disliking exposure to light, they may, by chance, attempt to take shelter in the ear, the disagreeable odour of wax would soon drive them out, or at all events, they could never get further than the drum. A small beetle has been known to get into the ear, but it did no further injury than produce a strange tingling sensation, by crawling about the drum, and soon made its exit. The common name given to this insect has been variously explained. In Scotland it is called *coachbell.* It has been suggested that *earwig* may be a corruption of *earwing*, from the resemblance in shape that its wings bear to a human ear, an explanation which does not seem improbable.

The Dragon-flies form a large family (LIBELLULIDÆ). There are a good many native species. The Dragon-flies (*Libellula depressa*) are essentially carnivorous. Like almost all animals of prey, they pass their life in isolation, and only associate with other individuals of the same species in obedience to the laws of reproduction. In the conditions of larva and pupa, they live at the bottom of our ponds and brooks. Here, imbedded in the mud, they wait patiently until some insect, or mollusc, or even some very young fish, comes within their reach. They then uncoil a very singular kind of weapon, something like the spring of a watch, which represents in them the lower lip. This is a sort of animated mask, armed with serrated and strong pincers, and supported by articulated pieces, the entire length of which almost equals


LARVA OF DRAGON-FLY.

that of the body itself. This mask acts at once like a lip and an arm, seizing the prey in its passage, and conveying it to the mouth. When the time of its metamorphosis arrives, the larva draws itself out of the water in which it has lived for nearly a year, and climbs slowly up some neighbouring plant, where it suspends itself with its head downwards. The sun soon dries and hardens its skin, which suddenly bursts and splits. The dragon-fly first disengages its head and its thorax. Its legs and its wings, which are still soft and without strength, gradually become firmer as they come in contact with the air, and in the course of a few hours they have acquired all their vigour. The dragon-fly then at once abandons the dull and muddy covering, in which it had been so long enveloped, throwing it from it like a cast-off garment; and having become a perfect insect, it darts forward in search of prey. It may then be seen hovering round its native pools, sometimes poising itself like an eagle or vulture, and sometimes, describing rapid circles, it falls like a dart upon some unfortunate insect, which it seizes and devours without pausing in its flight.

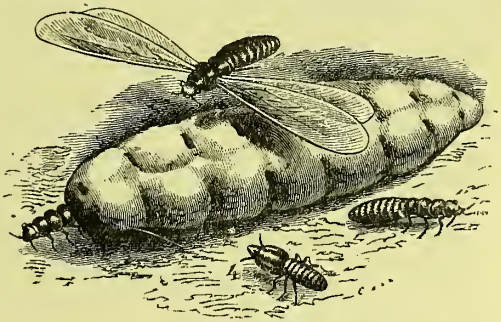


MAY-FLIES (*Ephemera*).

The May-flies, or EPHEMERIDÆ, form another family. The larvæ and nymphs of these insects live at the bottom of the water between stones, or in the ooze; some dig horizontal passages, in which they move very rapidly. In these two states they live two or three years before changing into perfect insects. The larva has always three thread-like filaments attached to its abdomen, of which the middle one in many species disappears after the metamorphosis. It is distinguished especially from the perfect insect by longer antennæ, by stronger upper jaws, and by external respiratory organs at the first six rings of the abdomen. Some larvæ have on each side of every ring two small plates. The change from nymph to perfect insect occurs in Ephemera swammerdamii so suddenly that there is almost at the same moment a creeping and a flying creature. In other species, as in those observed by Roesel, the change takes place more slowly. They moult once again in their perfect condition; and if we be walking by the banks of the water over which they are flying we may often see this moulting performed on our clothes.

In the middle of summer the may-fly takes wing towards evening. The time of flight differs in different species. That which Swammerdam described shows itself nearly three days in succession, about St. John's Day, in the month of May, and often in such quantities that it is as difficult to count these little creatures as falling snow-flakes. A great many fall into the water a prey to fishes, and at that time, especially at Dordrecht, the roach is noted as being peculiarly fat and good. Hence the name bank-bait (in some parts of France, *la manne*). According to the relation of Scopoli they are collected by the country people in Carinola to manure the land. Ephemeræ on the whole live as perfect insects but a short time, some not even a single day.

There is no more interesting family than that of the TERMITIDÆ. The species are generally known as white ants. Quatrefages tells us that, "like bees and ants, they combine together into numerous societies, in which individuals of different form represent various castes and perform distinct functions. The singular habits of these insects, which render them so formidable, have given rise to many fables. It is probable that the termites are those ants which, according to Herodotus, inhabited the country of the Bactrians, and which, smaller than a dog, although larger than a fox, devoured a pound of meat each day. Living in remote sandy deserts, these gigantic insects dug subterranean habitations, and raised up hills of golden sand, which the Indians carried away at the peril of their lives. According to his usual custom, Pliny endeavoured to make the marvellous history still more wonderful, by adding that the horns of these ants might still be seen in the temple of Hercules. Almost in our own day even, and when the termites were tolerably well known, some travellers have apparently found it difficult to content themselves with facts, although these are certainly curious enough of themselves. It has, for instance, been stated that these insects possess so active a poison, that merely to respire the emanations proceeding from them was sufficient to produce death, and that a single bite excited a mortal fever. An English naturalist (Smeathman) has thoroughly analysed these narratives, and the facts which he gives us in relation to the exotic species are not less marvellous than the errors propagated by his predecessors. This, however, is a result which very often occurs, for, in respect to the marvellous, Nature almost always exceeds all that has been devised by human imagination.


TERMITES: MALE, FEMALE, AND NEUTERS.

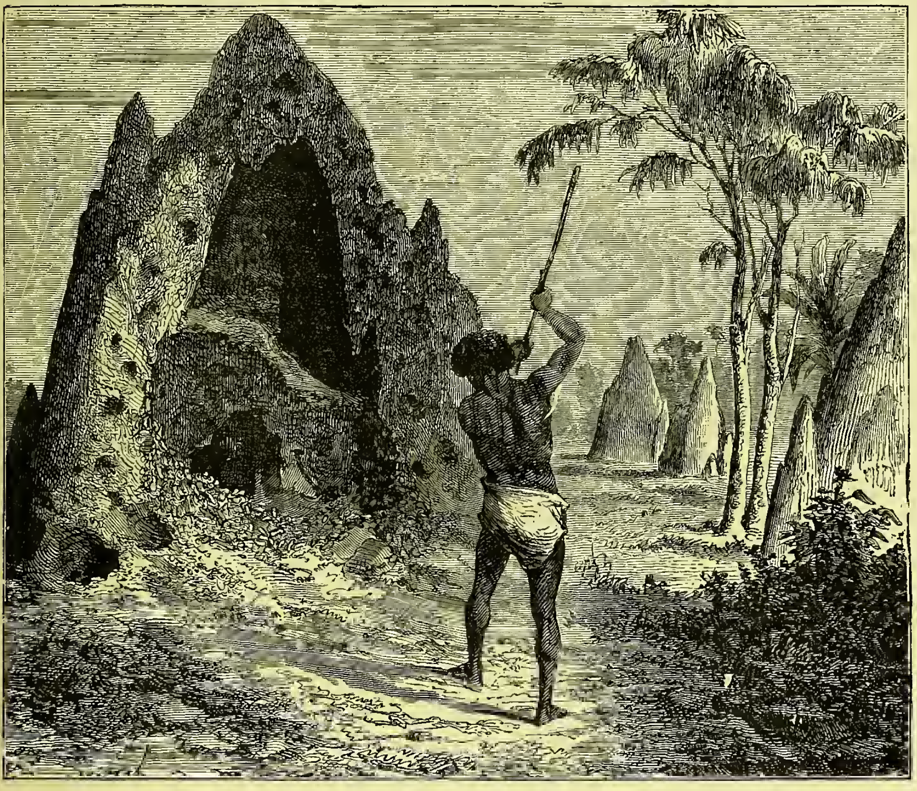
"Like the great majority of insects, the termites proceed from an egg, and before they assume their definite forms undergo various metamorphoses. In every termite's nest we meet with larvæ, nymphs, and perfect insects, accompanied by an immense number of neuters. Among bees and ants, the latter play the part of the workers, but amongst the termites they fulfil the functions of soldiers, and are exclusively charged with watching over the common safety, as well as in maintaining good order. The larvæ and nymphs, instead of wasting in complete inactivity the time destined for their metamorphoses, perform all the labours that are required in the community. It is they which erect their edifices, dig the mines, amass provisions, and surround the common mother, whose eggs they receive and cherish.

"Although charged with the performance of the most laborious duties, they are of very small size; the workers of Termes bellicosus, which is the largest of the species observed by Smeathman, are only about one-fourth of an inch long, while twenty-five of them scarcely weigh a grain. They are not, therefore, larger than our ants, which they so much resemble that the same name was long since given to them. Their entire body is of such extreme delicacy, that they are crushed by the slightest touch; but their head is provided with serrated mandibles, of so strong and horny a substance as to enable them to attack the hardest bodies, excepting only metals and stones. The soldiers are about double their length, and weigh as much as fifteen of the workers. This excessive weight is due to their enormous horny head, which is much larger than the body, and is armed with sharp pincers, true weapons of offence which cannot serve for purposes of ordinary labour. Finally, the perfect insect is sometimes as much as six or seven-tenths of an inch in length. It weighs as much as thirty workers, and the wings, which it possesses only for a few hours, are two inches and a half from tip to tip. We shall presently see what singular modifications appear to have been impressed upon the females by the very nature of the part which they are destined to play.

"All the species of the termites are miners, and most of them, moreover, are architects. Some among them build their nest on trees around a large branch, which these destructive insects well know how to respect when it suits their purpose. These nests are often as large as a sugar barrel, and although they present a broad purchase to the storms of the tropics, and are composed entirely of small parcels of wood, glued together by means of the gums of the district, and the juices yielded by the workers themselves, they are never torn away. Very few species live in the open air, for the greater number construct above their subterranean galleries edifices that enclose their storehouses and nurseries. The Termes atrox and the Termes mordax thus erect true columns surmounted by a roof or dome, which projects on all sides. These columns are about three-quarters of a yard high, and about a quarter of a yard in width. They are entirely constructed of a sort of clay, which acquires an extraordinary degree of hardness after it has been worked by the termites. It is easier to tear up one of these columns from its foundation than to break it through the middle. The interior is hollow, or rather, it is entirely composed of irregularly-shaped cells, which serve as lodgings. When the number of the inhabitants augments a new column rises by the side of the former one, and so on, until the nest of one of the two species just named bears no inconsiderable resemblance to a group of monstrous toadstools.

"If, however, we would see the termites display all the industry that the Creator has bestowed upon them, we must follow the example of Smeathman, and visit and demolish piece by piece a nest of the Termes bellicosus. When a colony of the latter establishes itself in the midst of a plain, one or two conical towers are first observed to protrude above the surface of the ground, and, growing rapidly, they soon multiply and attain a height of five feet. The extent of the soil occupied by these temporary edifices corresponds with that of their subterranean works. The diameter of these towers gradually increases, their base extends, and in a short time they touch one another and become cemented together. The void which before had separated them then rapidly disappears, and in less than a year the nest presents externally the appearance of an irregularly conical hillock, having around it a dome-shaped summit, bearing on its sides a variable number of elongated eminences, and having at its base a diameter of five or six yards, with nearly the same degree of height. If we take into account the difference of size of the architects, we find, on comparing the hillocks constructed by these insects with the most colossal monuments erected by the hand of man, that the result is such as to excite in us a sentiment bordering on humility. The pyramid of Cheops was, at the time of its construction, and before the base had been blocked up by the accumulation of sand, 479·640 feet in height. It was, consequently, then about ninety-six times the height of a man, if we assume the average human stature at five feet. From what we have already said in respect to the size of the termites, and of the hillocks which they erect, the latter must be about a thousand times higher than the height of the insects which constructed them. Thus, if we take all the different proportions into account, we find that these edifices of the termites are relatively eleven times higher than the loftiest of our monuments. In order to reach to an equal height, the great pyramid must be elevated more than a mile above the ground, which would give a height superior to that of the Puy de Dôme.

"These artificial hills possess a degree of solidity that is proof against most attacks. While they are still in the course of construction, and when their rounded domes are accessible to the wild bulls, these animals may often be observed standing on their summits as sentinels to the rest of the herd. Smeathman, Jobson, and other travellers, were in the habit of climbing up to the top of these hillocks in order to obtain a view of the surrounding country; or they lay in ambuscade among the turrets of these edifices in order 'to shoot at deer or wild beasts,' and yet these columns and hillocks are entirely hollow. Situated in the centre of the ground worked by each colony, these edifices may be said to constitute the capital of the community; and like our own large cities they have their public streets and squares, through which a numerous population is seen passing to and fro; their magazines always well filled with provisions; their foundling hospitals, in which new generations are reared by the care of the community; and, lastly, the palace of their sovereigns, who are in truth the actual father and mother of their subjects. I would advise my readers to consult the curious sketches which Smeathman has made of different sections of these hillocks. On examining his drawings, we first see the walls, which are as hard as brick, and measure from one to two feet in thickness. More or less cylindrical galleries pierce these walls, and increase in diameter towards the base, where the largest of them are fourteen inches in width, and penetrate between four and five feet under ground. These subterranean galleries are at once quarries and drains for carrying off the extra moisture. It is from here that the materials necessary for the erection of the building have been obtained, while, in case of inundation, they carry off the water to a considerable depth below the soil, and thus prevent it from reaching the populous quarters of the nest. The other galleries, which pass obliquely in every direction, intersect one another, and by extending to the dome and to the smallest turrets they serve as routes which are used by the workers engaged in building operations. Even this does not constitute the town itself, but is rather to be considered as its ramparts.



AN ANT-HILL (*After Smeathman.*)

"The whole of the interior is not quite filled. Below the dome lies a large free space, occupying the entire width of the hillock. The height of these attics equals very nearly the total elevation. The ceiling is flat and has no opening in it, but some of the galleries which run through the general envelope open on a level with it. Other galleries open at different heights, and are continued by steps resting against the wall, like the stairs in the interior of the cupola of the Pantheon. These are so many scaffoldings, which enable the workers to reach every part of the vault. As to the attics, they serve the part of a double flooring, or an air-chamber, whose utility may be readily understood when we consider the intense noontide heats and the bitterly cold nights of those regions. This upper chamber thus secures equable temperature throughout the entire building, whilst it screens the nurseries, which are situated below it, from daily variations of heat.

"Having passed in review the walls, cellars, and attics of the building, we will now proceed to the apartments themselves. On a level with the soil, and on the centre of the ground floor, rises the palace of the sovereigns, which we are now about to describe. This royal chamber is a large oblong cell, with a flat floor, and a rounded vault, which, when first formed, measures about an inch in length. The walls are very thick, more especially in the lower part, and are pierced with round doors and windows, at regular distances from one another. All around this sanctuary, extending for a space of more than a foot in diameter in all directions, there appears a perfect labyrinth of vaulted chambers, which are always round or oval, and which either communicate freely with one another, or open into wide passages. These are the waiting-rooms, exclusively appropriated to the use of the workers and soldiers, who are in attendance on the royal pair. On the sides rise, to the very roof of the attics, storerooms which line the wall of the general covering. These are large irregular cells, which are always filled with gums and the solidified pieces of plants, reduced into such minute particles, that the microscope alone enables us to recognise their true nature. Galleries and small empty cells connect together all these well-stored chambers, and secure a free passage to the attendants.

"The royal chamber and its dependencies are protected by a thick vault, the upper part of which serves to support a large empty space situated in the very centre of the hillock. On this kind of area rise massive columns, which give to this vast hall the appearance of the nave of a cathedral. These pillars support the nurseries, which differ from the rest of the edifice as much in their structure as in the objects for which they are intended. In every other part of the edifice clay is the only material employed, and even in the nurseries it forms the skeleton of the cells; but here the large apartments in which the eggs are to be hatched, and in which the very young larvæ remain for a time, are subdivided into a great number of little cells, whose walls are entirely constructed of parcels of wood, glued together with gum. Nurseries of this kind are found of all sizes, and some of them are as large as the head of a child. All of them are surrounded by a casing of mason work, interrupted by doors which open into the galleries or passages of communication, and being situated between the large air-chamber of the attic and the nave of which we have just spoken, they combine all the conditions favourable to equability of temperature and ventilation.

"We will now return to the royal chambers, which on being broken open is always found to enclose the one couple, who are the objects of the most assiduous care, but who purchase their greatness at the cost of perpetual seclusion; for the doors and windows of the chamber, although sufficient to admit of the passage of a worker or a soldier, are too narrow to enable the king, and *à fortiori* the queen, to pass through them. The royal mother of the community, who always rests on the ground in the centre of her habitation, at once attracts the attention of the observer. How slightly does she resemble that graceful insect, with delicate wings and slender form, which was only three or four times the length and thirty times the weight of a worker! Her wings have disappeared; but, while her head and thorax remain almost unchanged, her abdomen has, on the contrary, acquired an enormous development, which seems to have no limit. In an old female, it is fifteen hundred or two thousand times larger than the rest of the body, and it reaches a length of nearly six inches. At this time her weight is equal to thirty thousand workers; and in consequence of this excessive enlargement, the precautions taken to prevent her flight are perfectly useless, for she is unable to advance a single step. The male has also lost his wings, but he is not changed in any other respect either as to dimensions or form. Nevertheless, he makes little use of his power of locomotion, and is generally hidden under one of the sides of the vast abdomen of his companion.

"The workers and soldiers appear to pay very little attention to the king, but their devotion to the queen is excessive. The space that is left free round the latter is constantly filled by several thousand eager attendants, who move round her, always turning in the same direction. Some feed her, others remove the eggs which she is unceasingly laying; for here, as in the case of the bees, the queen is the actual mother of her subjects, and her productiveness is truly marvellous. If it were not for the immense number of labourers which each colony must contain, in order to accomplish such vast works, it would be difficult to believe the details which Smeathman declares he has repeatedly verified. This monstrous abdomen seems to be nothing but a vast ovary, whose multiplied branches enclose so large a number of germs in the course of development that there are always some that have reached maturity. These canals may be seen through the attenuated and transparent integuments presenting incessant peristaltic or vermicular motions, first at one point and then at another. By means of this mechanism, the female termite, probably almost involuntarily, lays upwards of sixty eggs in a minute—that is to say, more than 80,000 in a day; and Smeathman is led to believe that this prodigious quantity is deposited with the same activity throughout the whole year.

"These myriads of eggs being promptly collected, are carried into the nurseries, and very soon there issue from them a like number of larvæ, similar to the workers, but smaller in size, and of a snow-white colour. These larvæ continue to live for some time in the cells in which they are hatched. Here they are the objects of the most attentive care, the very walls which shelter them seeming to be changed into hot-beds, to furnish materials for their nourishment. Owing to the humid heat which prevails at all times in the centre of the nest, the partitions of wood and gum which form the nurseries are soon covered with microscopical fungi, very similar to our mushrooms, and the young termites find in this mould a species of food adapted to their early wants. They no doubt undergo some first metamorphosis, and subsequently assume the form of the active labourers or soldiers. The former alone attain the condition of perfect insects.

"Towards the beginning of the rainy season their wings become fully developed, and, selecting some stormy evening for the period of their flight, the males and females issue by millions from their subterranean retreats. Their aërial life is, however, of very short duration, for after a few hours their wings wither and fall off. On the following day the earth appears thickly strewn with the bodies of these hapless insects, and being henceforth incapable of flight, they fall an easy prey to the thousand enemies who are anxiously watching for this animal food. Only a small number escape the general massacre. A few couples collected by the labourers, and protected by the soldiers which chance has led near them, return into their galleries, and generally become the sovereigns of those who have saved them. Soon enclosed within the royal cell, they form the nucleus of a new community, and have nothing more to think of but to endeavour to augment the numbers of their subjects.

"All travellers speak of ants being used by certain nations as an article of food. This remark, however, applies only to the termites, and there is no doubt that man must be classed among the enemies who annually watch for the emigration of these insects, with the view of securing them for food. The Indians smoke the nests, and stop the winged insects as they are hastening to escape from their habitation. The natives of Africa, with less industry, content themselves with collecting those which fall into the neighbouring waters. The Indians pound these insects into a paste, and mixing them with flour convert them into a sort of cake; while the Africans content themselves with roasting them very much in the same manner as coffee beans, eating them by handfuls, and declaring that they thus constitute a most delicious article of food. However strange such viands may appear, they seem to be relished even by Europeans; and all travellers agree in speaking of the termites as a savoury and agreeable article of food, resembling in flavour sweetened marrow or cream. Smeathman regards them as a delicate, nourishing, and wholesome food, and he seems even to prefer them to those famous palm grubs which in the West Indies are brought to the tables of the rich as an exquisite delicacy.

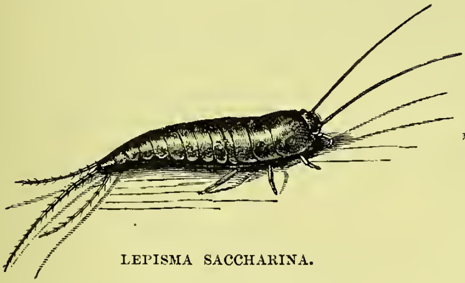
"The neuter termites preserve through the whole of their lives the characters and attributes which have obtained for them the name of soldiers. Although they hardly number one-hundredth part of the population of the termites, they constitute a separate class, which a writer of the last century would undoubtedly have compared to the nobility of a monarchy, whilst the larvæ would have represented the plebeians of the community. At ordinary times they live idle, keeping guard or merely watching the labours of the workers, over whom they exert an evident authority. In times of war they bravely risk their persons, and sacrifice themselves, if necessary, for the common safety. At the first stroke of the pickaxe, which lays open one of their galleries, the nearest sentinel is observed to hurry forward. The alarm spreads, and in the twinkling of an eye a crowd of combatants cover the breach, moving their large heads in all directions, and opening and shutting their forceps with a loud noise. When once they have seized any object, nothing will make them relinquish their hold; they will allow their limbs and body to be torn in pieces without unlocking their jaws. If they can reach the hands or legs of the aggressors, they at once draw blood. Each termite will cause a loss of blood exceeding the weight of its own body. Thus the negroes who are without shoes and only half clothed are soon put to flight, whilst even Europeans leave the combat with their clothes deeply stained with blood.

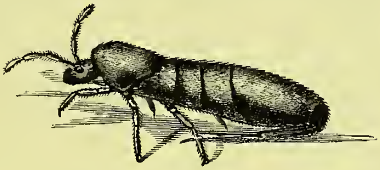
"While they are engaged in fighting, the soldiers strike the ground from time to time with their forceps, and the labourers reply to this well-known signal by a sort of whistling noise. As soon as the attack ceases, the masons appear in crowds, each carrying in its mouth a piece of clay already prepared. Each in turn approaching the part that needs repair, applies to it his portion of mortar, and then again retires without embarrassing or interfering with his companions. The new wall is rapidly constructed under the eye of the observer. During this time the soldiers remain in the interior, with the exception of one or two to every thousand labourers. One of them appears to be charged with superintending the works; for during the building of a wall he stands as a superintendent, slowly turning his head in all directions, and striking the dome rapidly every two or three minutes with his forceps, which produces a noise rather louder than that of the ticking of a watch. This noise is each time responded to by a whistling sound, which proceeds from all parts of the edifice, and is invariably accompanied by an exhibition of increasing activity on the part of the labourers. If the attack recommences, the labourers disappear in the twinkling of an eye, and the soldiers return to their posts, where they maintain the contest with the greatest obstinacy, defending the ground inch by inch. The labourers in the meantime are not idle, for they block up the passages and galleries, and appear especially anxious to guard their sovereign. With this intention, they fill up the waiting-rooms with the greatest possible celerity, and effect their purpose so completely that Smeathman, on reaching the centre of one of these edifices, was unable to distinguish the royal chamber, which was lost in the midst of a shapeless mass of clay. The vicinity of this palace is, however, betrayed by the crowd of labourers and soldiers who are collected around it, and who allow themselves to be crushed rather than abandon the spot. The cell itself always contains several thousands of the community, who have remained and suffered themselves to be immured with the royal pair. Smeathman always found that they readily allowed themselves to be carried away with these objects of their devoted attachment, and that they continued their services in captivity, being incessantly engaged in moving round the person of the queen, giving her food, and removing her eggs, which, for want of nurseries, they deposited behind broken pieces of clay, or in some retired portion of the bowl which served as their prison.

"It is scarcely possible to obtain a view of the termites without destroying their works. Chance may, indeed, sometimes enable the traveller to see a colony of these insects while they are proceeding from one habitation to another, as in the case of Smeathman, who had the pleasure of seeing one of their armies march by him, but in general they do not appear above ground. Every nest that is built on a level with the soil, or below it, is characterised in all the species by having subterranean galleries, which radiate in all directions, and often to very considerable distances from the point of their origin. Even the tree termites construct a large tube which reaches to the ground, and serves as the centre of their covered roads. All the species, moreover, have the same habits, and their innumerable squadrons are incessantly on the watch to discover some organic body which they may devour; and this instinct renders them so formidable to man, that Linnæus has not hesitated to designate them as the greatest scourge of the Indians. Invisible to the eyes of those whom they threaten, the termites carry their galleries to the very walls of inhabited buildings or storehouses, descend beneath the foundations, and make their way up again through the interior; and from this time they are entire masters of the place. Some attack the woodwork, the furniture, and provisions of every kind, whilst others, without deviating from their course, demolish the floors and roofs; but being always careful of avoiding the light, they scrupulously respect the surface of the objects which they attack, and content themselves with gutting the interior. If the spot appears favourable to them, and there seems much to be attacked, they bring with them mortar to replace, piece by piece, the woody structures which they have destroyed; and Smeathman has seen wooden posts thus changed into hard clay columns. If the contrary be the case, they are less cautious, and their work of destruction progresses with such amazing rapidity that one season suffices for the complete destruction of a house built in the European fashion, while a negro village completely disappears within the same period. They have been known to penetrate in a single night through the foot of a table, and, traversing the leg from below upwards, to attack a box which was standing upon it, and so completely to destroy the contents, that the next day not an inch of the clothing which it contained was found to have escaped their attacks; and even papers, drawings, and pencils, including the lead, had all disappeared in the same time." (*Quatrefages.*)

The family Psocidæ is a small one. One little insect (*Psocus pulsatorius*) located here is commonly found on wood, upon walls, in old papers, &c. It has superficially a resemblance to a louse, but runs very rapidly. The Latin specific name is derived from the idea that the ticking in old furniture and door-posts, which superstition often receives as a bad omen, is caused by this insect; but on the contrary, it is a small beetle which causes the tapping sound.

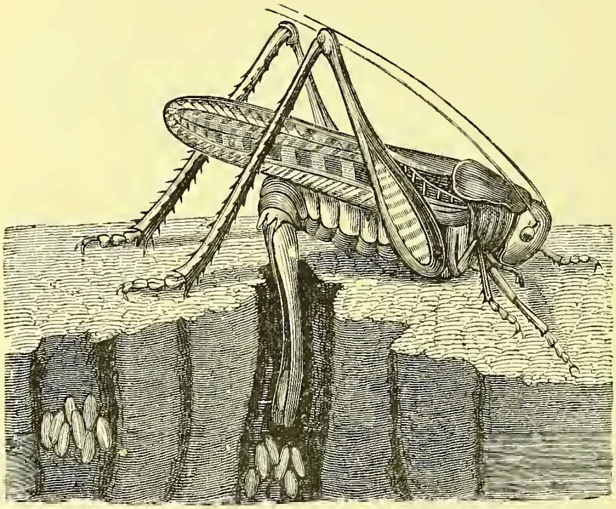
Here we find it convenient to place the Thysanura, containing the families Poduridæ and Lepismidæ. The reader of Kirby and Spence's well-known "Introduction to Entomology" will remember a letter in which, while treating of the motions of insects, the authors tell of a tribe of minute apterous beings found often under the bark of trees, on the surface of water, and in various other situations, which Linnæus has named Podura, a term implying that they have a leg in their tail. By this leg these little creatures can leap sometimes two or three inches. One minute black species, which is to be found in spring floating on the water of ruts and ditches, may often be seen in such vast numbers as to look like a heap of gunpowder, the black grains of which had been ignited. Another, called by Latreille Machilis polypoda, abounding at East Farleigh, near Maidstone, is said to have no less than eight pair of these spring legs—one on each ventral segment of the abdomen —by means of which it leaps to a wonderful distance, and with the greatest agility. It is of this little tribe of minute beings among the wingless insects that Sir John Lubbock has written an interesting Monograph.


LEPISMA SACCHARINA.


PODURA PLUMBEA.

The first detailed memoir on the group was written by De Geer, and was published shortly after the appearance of the first edition of Linnæus's "Systema Naturæ." The springtails had, however, attracted the attention of naturalists long before that date. More than a quarter of a century earlier than the birth of Linnæus, Rayger and Camerarius had written about and figured the insects that reached the ground with the softly-falling snow, and for many years afterwards there now and then appeared a paper on "Insecta nive delapsa," or "Schneewürmer," all of which are related to some one or other of the Thysanura. In America we find that these little creatures are at this day called snow-flies; and we notice in passing that Loew (F.) asserts that nearly one-fourth of the recorded European species have been met with on the surface of snow, although they may also be seen all through the summer's day.

Winter does not kill them, and the ever-active entomologist will find numbers of them to collect in all seasons. Franz Xaver von Wulfen wrote in 1788 a treatise under the title of "Winterbelustigungen;" and among the amusements of this season he enumerates the collecting of Thysanura. The indefatigable Latreille, in his seventieth year, and just before he died, published an extended memoir on the external anatomy of the Thysanura, and shortly after his death Mr. R. Templeton wrote a paper on Irish Thysanura, which is remarkable as being the first of any importance published in English. This paper appeared in the first volume of the "Transactions of the Entomological Society of London," and Mr. Woodward prefixed to it some very valuable remarks on the difficulty of deciding on the affinities of the group.



GRASSHOPPER DEPOSITING ITS EGGS.

Of the GRYLLIDÆ we find room to mention the large Grasshopper (*Acrida viridissima*). This is one of the largest and most conspicuous, both for size and song, of our native grasshoppers. He has rather a sharp head, large prominent eyes, ample wings, and slender antennæ as long as the body. This noble of his tribe is not an unfrequent resorter to hedges and marshy places; and though his green armour may easily escape notice, his loud chirping can hardly fail to attract attention, especially in the songsters' months of August and September. Many kinds of grasshoppers are the brethren of this grandee.

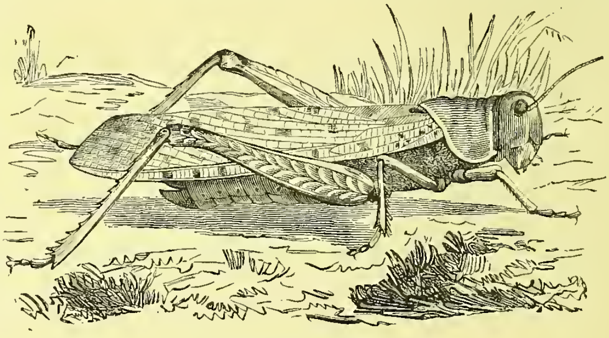
Wordsworth has not passed unheeded the

> " ——————jocund voice
> Of insects chirping out their careless lives
> On these soft beds of thyme-besprinkled turf."

But of the grasshopper it is said—

> " He is an evening reveller, who makes
> His life an infancy, and sings his fill."

Some grasshoppers were great favourites with the ancients, who often kept them in cages for the sake of their song. They were supposed to be perfectly harmless, and to live on dew; but they are vegetable feeders, and sometimes are very destructive. Some of the districts in the South of France are frequently quite ravaged by swarms of grasshoppers. Thus, in 1824, at Saintes-Maries, near Marseilles, no less a sum than 6,000 francs was spent on collecting over 1,500 corn-sacks full; and at the same place in 1833 nearly 8,000 lbs. weight of their eggs were collected. About 40,000 eggs weighed one pound.



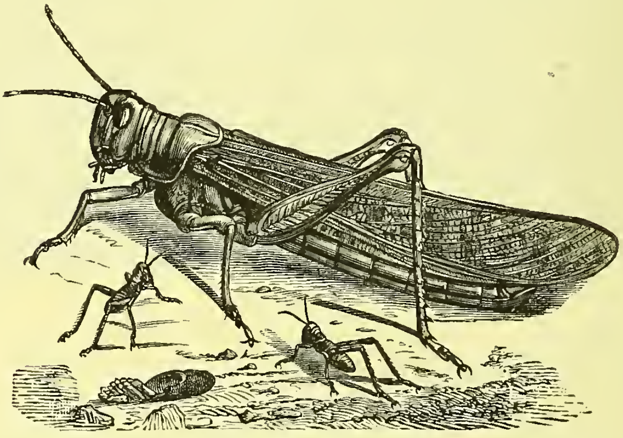
THE LOCUST (*Locusta migratoria*).

The Locust of Inner Arabia (*Locusta migratoria*) is thus graphically described by Palgrave:—

"The ground glimmered white to the moon, and gave a firm footing to our dromedaries, who by their renewed agility seemed to partake in the joy of their riders, and to understand that rest was near. We were, in fact, all so eager to find ourselves at home and homestead, that although the town of Hofhoof, our destined goal, was yet full fifteen miles to the north-east, we pressed on for the capital. And there, in fact, we should have all arrived in a body before day-dawn, had not a singular occurrence retarded by far the greater number of our companions. Soon after the crags in our rear had shut out, perhaps for years, perhaps for ever, the desert and Central Arabia from our view, while before and around us lay the indistinct undulations and uncertain breaks of the great Husa plain, when on a sloping bank at a short distance in front we discerned certain large black patches, in strong contrast with the white glister of the soil around, and at the same time our attention was attracted by a strange whizzing like that of a flight of hornets, close along the ground, while our dromedaries capered and started as though struck with sudden insanity. The cause of all this was a vast swarm of locusts, here alighted in their northerly wanderings from their birthplace in the Dahnā. Their camp extended far and wide, and we had already disturbed their outposts. These insects are wont to settle on the ground after sunset, and there, half stupefied by the night chill, to await the morning rays, which warm them once more into life and movement. This time our dromedaries did the work of the sun, and it would be hard to say which of the two were the most frightened—they or the locusts. It was truly laughable to see so huge a beast lose his wits for fear at the flight of a harmless, stingless insect. Of all timid creatures none equal the 'ship of the desert' for cowardice. But if the beasts were frightened, not so their masters; I really thought they would have gone mad for joy. Locusts are here an article of food—nay, a dainty—and a good swarm of them is begged of heaven in Arabia no less fervently than it would be deprecated in India or in Syria. This difference of sentiment is grounded on several reasons; a main one lies in the diversity of the insects themselves. The locust of Inner Arabia is very unlike whatever of the same

FLIGHT OF LOCUSTS.

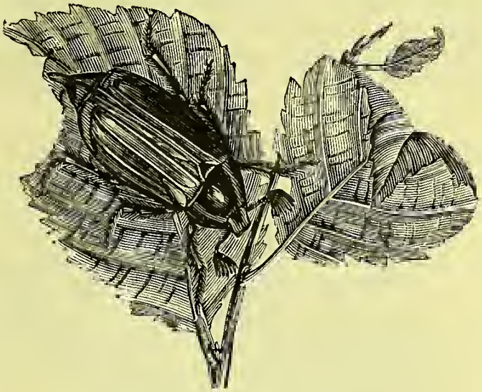
genus I have seen elsewhere. Those of the north are small, of a pale green colour, and resemble not a little our own ordinary grasshoppers. They are never, to my knowledge, eaten by the Bedouins or villagers of Syria, Mesopotamia, and Irak, nor do I believe them eatable under any circumstances, extreme hunger perhaps alone excepted. Like bees, they have a queen, whose size is proportioned to her majesty ; but, like bees in this point also, locust queens do not lead the swarms, but keep retired state. The locust of Arabia is, on the contrary, a reddish-brown insect, twice or three times the size of its northern homonym, resembling a large prawn in appearance, and as long as a man's little finger, which it equals also in thickness. Among these locusts I neither saw nor heard of any queen, a deficit which tends to class them with the species 'Arbah' of the Bible, as described in the penultimate chapter of the Proverbs. When boiled or fried they are said to be delicious, and boiled and fried accordingly they are to an incredible extent. However, I could never persuade myself to taste them, whatever invitations the inhabitants of the land, smacking their lips over large dishes full of entomological 'délicatesses,' could make me to join them. Barakāt ventured on one, and one only, for a trial. He pronounced it oily and disgusting—it is caviare to unaccustomed palates. The swarm now before us was a thorough godsend for our Arabs, on no account to be neglected. Thirst, weariness, all was forgotten, and down the riders leapt from their startled camels ; this one spread out a cloak, that one a saddle-bag, a third his shirt over the unlucky creatures destined for the morrow's meal. Some flew away, whirring across our feet, others were caught and tied up in cloths and sacks. Cornish wreckers at work about a shattered East Indiaman would be beaten by Ghannām and his companions with the locusts. However, Barakāt and myself felt no special interest in the chase, nor had we much desire to turn our dress and accoutrements into receptacles for living game. Luckily, Aboo-Eysa still retained enough of his North Syrian education to be of our mind also. Accordingly we left our associates hard at work, turned our startled and still unruly dromedaries in the direction of Hofhoof, and set off full speed over the plain."



LOCUST AND YOUNG.

ORDER III.—COLEOPTERA.

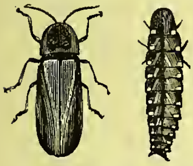
The insects belonging to this order have also four wings. In most of the species the anterior pair are hard, and act as covers or shields (κολεός, sheath) to the hinder pair, which are membranous and act as organs of flight. In some, the posterior wings are wanting, and in the females of several species both pairs are absent (glow-worm, stylops). The mouth is formed for mastication, and their metamorphosis is complete. There are upwards of 35,000 species known, and there are probably over 3,500 species native of Great Britain and Ireland. This vast group may be divided into four sections, as follows :—



THE COCKCHAFER (*Melolontha vulgaris*).

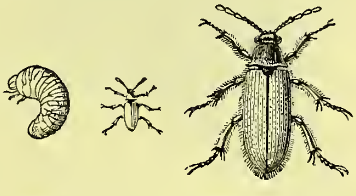
I.—PENTAMERA.

In this group all the tarsi are five-jointed, the fourth being of ordinary size. Here we find many species known to us from the destruction they cause. One (Lymexylon navale) causes immense mischief in our shipbuilding yards to oak timber; another, the Cockchafer (*Melolontha vulgaris*), often does great mischief to the roots of plants. Here is the Death-watch (*Anobium striatum*), which, when in its larval stage, bores into furniture and alarms the timid by its ticking noise. Here, the Wingless Glowworm (*Lampyris noctiluca*), whose lamp has often been the poet's theme. She lights it to attract the well-winged male—



Male. Female.

THE GLOWWORM (*Lampyris noctiluca*).



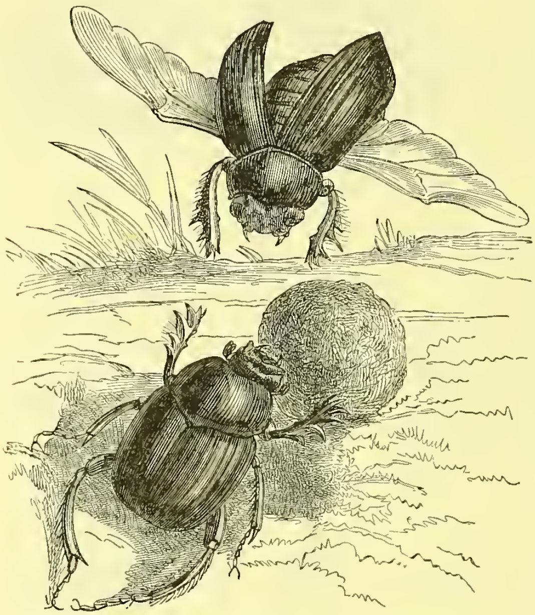
THE DEATH WATCH (*Anobium striatum*).

Larvæ: Natural Size and Magnified.

> "Beautiful as is the light,
> The glowworm hangs out to allure
> Her mate to her green bower at night."

To this group also belong the Stag-beetles (Lucanus), the Rose-chafers (Cetonia), the Sacred Beetle of the Egyptians (Scarabeus), allied to which are some of the largest of the beetles, one of which, Dynastes hercules, found in Brazil, measures about five inches in length. Sir William Wilde thus writes of the Sacred Egyptian Beetle:—"Another little animal that particularly called my attention, and excited my admiration, was the Scarabæus, or Sacred Beetle. Numbers of these were running about in all directions in the warm sunshine, engaged in rolling their balls over the desert with such industry, and in so curious a manner, that I cannot refrain, although on the path to the Pyramids, from stopping to notice the insect so famed in Egyptian story, and that formed so conspicuous a part in the symbolic language and the mythology of this ancient people. The more I consider the habits and manners of animals, the more am I convinced that it was an accurate observation of their natural history and instincts that attracted the attention of the ancients, and on which was formed much of their mythological system and hieroglyphic character. This was not peculiar to the Egyptians, for we find the car of Bacchus drawn by tigers, evidently alluding to the conquest of a country to which those animals were peculiar; and in like manner are represented the conquests of Alexander, not expressed in words or by any written character, but shown forth by the representations of the animals peculiar to each region, as depicted in the Mosaic pavement at Præneste.

"These little creatures, the Scarabæi, which are possessed of amazing strength and perseverance, form balls of clay and camel's dung, which they mix up into a kind of mortar, very like that used by swallows to construct their nests. In these they deposit their eggs, and thus it forms a crust or shell to the larvæ within; they then roll these balls, when sufficiently dried, over the sand in a truly remarkable manner. The male is provided with two projections in the form of horns on the head, and uses them as a lever to raise and push the ball forward from behind, while the female, mounting before, keeps it revolving onward by drawing it down with her fore feet. Sometimes three or four will gather about one ball, either for the mere sake of work, or to get it over any impediment. Others again propel them with their hind legs, and will sometimes assume the most grotesque attitudes, literally standing on their heads and pushing at them with their hind feet. So far as I am able to judge, they keep rolling these balls about over the sand for the whole day, and do not place them at once in holes, like other coleopterous insects. I have watched them at evening, and as soon as the sun had set they invariably deserted their charge, and returned to their holes; and what is more remarkable, if the day became suddenly clouded, off they waddled, and left the ball till a gleam of returning sunshine called them again to work with renewed vigour. It appears to me, from the manner they rolled these balls, that they intended the sun should act equally on all sides of them, and thus secure a certain temperature in the process of incubation. It may, however, be but for the purpose of drying the surface. The sexes of these beetles are well known to the Arabs, one of whom, who could just speak a word or two of English, pointed out the difference in the forms of the 'men' and the 'women' Scarabæi.

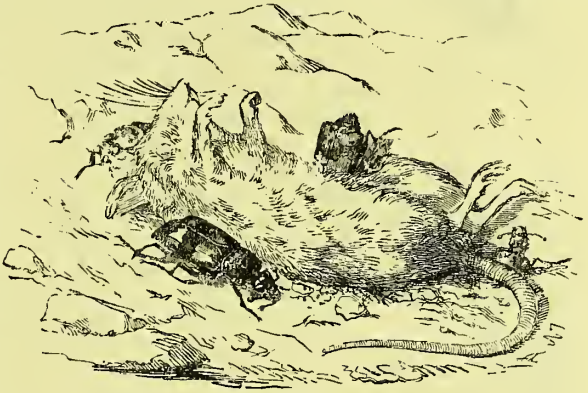

SACRED BEETLES OF THE EGYPTIANS (*Scarabeus sacer*).

"Scarabæi, in every shape and attitude, and of all sizes, are figured on the Egyptian monuments, are used in the hieroglyphics, and models of them are generally found on the breasts of mummies; besides, many of a smaller size form part of the necklaces worn by such. In these two latter positions they may have been used as amulets. Others are carved in different stones and gems, as signets, having the names of the various Egyptian kings cut in hieroglyphics on the face. It was the emblem of creative power, of the earth and of the sun, in which latter case the ball alone is often used."

Here also would be located the Burying Beetles (Necrophaga). Of our common native species (*Necrophaga sepultor*), a pleasant writer in the *Entomological Magazine* gives us the following account:—"Waring Kidd had shot a bullfinch, but it was spoiled for stuffing, and thrown down as useless by the side of the path just by the bath. It was on this bullfinch, and in this situation, that I had the pleasure of seeing the burying beetle at work.

"The burying beetle is about an inch in length. He is black, with two bands across his back of a bright orange colour. These bands are formed by two blotches of orange colour on each of the wing-cases. He is a disgusting creature, though in such a gay dress, being so fetid that one's hands smell for hours after handling him, and if he crawls on one's coat, or other garments not often washed, the smell continues for days. The whole tribe of burying beetles lay their eggs in the bodies of dead animals, which, when possible, they bury for the purpose. In Russia, where death itself does not do away with distinctions, the poor people are buried but a few inches under ground, the coffin consisting of four boards roughly nailed together, and not particularly well fitted. The operation of burying is often at the expense of the country, and therefore done from necessity, not love. This mode affords great pleasure to the burying beetles, as it saves them the labours of the gravedigger. They avail themselves of the bodies placed so nicely within their reach, and the graves are pierced with their holes in every direction. At evening hundreds of these beetles may be seen in the Russian burying-places, either buzzing about the graves, or sitting placidly at the mouth of their burrows, which lead into them.

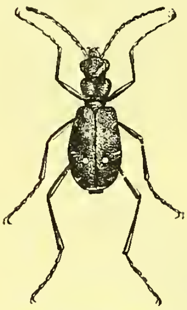
"The burying beetle in this country seldom finds so convenient a provision for him, and he is under the necessity of taking much more trouble. He sometimes avails himself of dead dogs or horses, but these are far too great rarities to be his constant resort. The common objects of his search are dead mice, rats, birds, frogs, and moles. Of these a bird is the most commonly obtained. In the neighbourhood of towns every kind of garbage that is thrown out attracts these beetles as soon as it begins to smell; and it is not unusual to see them settling in our streets, enticed by the grateful odours of such substances. The burying beetles hunt in couples, male and female; and when six or eight are found in a very large animal, they are almost sure to be males and females in equal numbers. They appear to hunt by the nose only, their movements being mostly made in the night, when the faculty of sight is of but little service.



THE BURYING BEETLE (*Necrophaga sepultor*).

"Now to the bullfinch. The beetle soon returned with his bride. Neither seemed at first to discover the exact spot. At last the male espied it, and great comfort he expressed, wheeling in circles about eighteen inches above it, in the manner of an eagle, only some half-dozen miles nearer the earth. The female settled on it at once, without this testimonial of satisfaction. The male at last settled also, and the bird underwent the scrutiny of four at least of the senses—touch, smell, sight, and taste—for the heads of both were continually diving among the feathers of the bird, and a savoury and ample meal was made before the great work of burying was begun. After the beetles had appeased the calls of hunger, the bird was abandoned for a while, both of them examining with great care the earth all round, to see whether it was a decent place for a funeral. Being satisfied as to the decorum of the thing, the operation of burying was commenced by the male; the lady mounting the bird, and for a time sitting quietly upon it, then hiding herself among the feathers, and allowing herself to be buried with it. The male began by digging a furrow all round the bird, at the distance of about half an inch, turning the earth outside. His head was the only tool used in this operation; it was held sloping outwards, and seemed prodigiously powerful.

"After the first furrow was completed, another was made within it, and the earth was thrown into the first furrow. Then he made a third furrow, but this was under the bird, so that I could only see a bit of him now and then, and I could only judge for a long time of what was going on by the heaving of earth, which formed a little rampart round the bird. As the rampart rose the bird sank. After three hours' incessant labour the beetle emerged, crawled on the bird, and took a survey of his work. Here he remained about an hour, still as death; he did not stir hand or foot. He then dismounted, dived again into the grave, and kept on pulling the bird down by the feathers for half an hour; its own weight seemed to sink it but very little. The earth then began heaving and rising all round. It was for all the world like a little earthquake. The feathers of the bird were again pulled, and again the bird descended. At last, after about three hours' more labour, he came up, mounted on the bird, took a survey, and then dropped down to rest as though dead, or suddenly fallen fast asleep. When sufficiently rested, he roused himself, trod the bird firmly into its grave, pulled it by the feathers this way and that way, and, having settled it to his mind, began to shovel in the earth. This he did in a very short time, by means of his broad head. He went behind the rampart of earth, and pushed it into the grave with amazing strength and dexterity, his head being bent downward at first, and then the nose chucked up with a kind of jerk, which sent the earth forwards. After the grave was thus filled up, and the earth trodden in, it underwent another keen scrutiny all round, the bird being completely hidden. He then made a hole in the still loose earth, and having buried the bird, and his own bride, next buried himself."

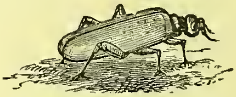


THE TIGER BEETLE.

The Short-winged Beetles (Brachelytra), the Water Beetles (Hydradephaga), of which the little Whirligigs (Gyrini) are so well known to the fisherman, and lastly, the immense section of the Carnivorous Beetles (Geodephaga), of which the common British Tiger Beetle (*Cicindela campestris*) may serve as a type, all belong to this section.

II.—HETEROMERA.

In this group the four anterior tarsi are five-jointed, and the two posterior are four-jointed. To it belong the Blistering Beetles (Lytta), which are mostly active, often finely-coloured insects. "These beetles," writes Kirby and Spence, "amply make up in efficacy for their numerical insignificance." Almost any article could be better spared from the *materia medica* than one of the species usually known under the name of Cantharides, which is not only of incalculable importance as a vesicatory, but is now administered internally in many cases with very good effect. In Europe the insect chiefly used with this view is the Cantharis vesicatoria; but in America the C. cinera and vittata (which are extremely common and noxious insects, while the C. vesicatoria is sold there at sixteen dollars the pound) have been substituted with great success, and are said to vesicate more speedily and with less pain, at the same time that they cause no strangury; and in China they have long employed the Mylabris cichorei, which seems to have been considered the most powerful vesicatory amongst the ancients, who, however, appear to have been acquainted with the common Cantharis vesicatoria also, and to have made use of it, as well as of Cetonia aurata and some other insects mentioned by Pliny. Another species of Mylabris has been described by Major-General Hardwicke in the "Asiatic Transactions," as plentiful in all parts of Bengal, Bahar, and Oude, which is fully as efficacious as the common Spanish fly; and in other parts of India Cantharis gigas and violacea are employed, as is C. syriaca in Arabia; and in some parts of Europe Lytta (Mylabris, Fab.) trimaculatus is employed.



A BLISTERING BEETLE.

Burmeister says that the species used by the ancients appears to have been Mylabris Füeslini (Panzery), which is very abundant in the south of Europe, and is sometimes found in Germany. The active blistering principle in all these insects has been detected by M. Robiquet, and named by him Cantharidine, which has been ascertained by M. Bretonneau, and especially by M. Leclerc, who has examined a great number of insects with this view, to be found amongst coleopterous insects of the family of Cantharidæ only, though not in all the species of this family, nor even in all the species of the same genus. M. Leclerc, who conceives that cantharidine is secreted by a peculiar apparatus, states that it is not destroyed either by the action of the air or of time; and as it must exist in a spider of the United States which is there extensively employed as a vesicatory, he examined if this principle is to be found in the Tegenariæ of France or in other spiders, but without success.

The dull night-loving churchyard beetles (Blaps) also belong to this section.

III.—TETRAMERA,

In which, though the tarsi are five-jointed, yet the fourth joint is very small and mostly hid by the lobes of the other joints. One large tribe belonging to this group are vegetable-eaters (Phytophaga), and though for the most part small, are often most destructive.

One of the best-known species is the so-called Turnip-fly (*Haltica nemorum*). Kirby and Spence tell us "that the chief dependence of our farmers for the sustenance of their cattle in the winter is that most valuable root, the turnip, the introduction of which into our system of agriculture has added millions to our national revenue; and they have often to lament the loss and distress occasioned by a failure in this crop, of which these little animals are the cause. On its first coming up, as soon as the cotyledon leaves are unfolded, a whole host of these little jumping beetles, composed chiefly of Haltica nemorum, called by farmers the fly and black jack, but assisted also by other species, as H. concinna, attack and devour them; so that, on account of their ravages, the land is often obliged to be re-sown, and frequently with no better success. It has been calculated by an eminent agriculturist, that from this cause alone the loss sustained in the turnip crops in Devonshire, in 1786, was not less than £100,000."

Another tribe furnishes us with the magnificent long-horned beetles (Longicornia). The larvæ of these live in wood, often doing immense injury; and another tribe, distinguished by having the front of the head produced into a snout, are often called Elephant Beetles (Rhynchophora). Many species are known as weevils, and are destructive to corn and rice. The Nut Weevil (*Balaninus nucum*) is also a common species, the grub-like larva of which is so often to be found in hazel nuts.

Some of the species are very destructive to timber, and often destroy whole forests. One species (Hylurgus piniperda) has destroyed tens of thousands of pounds worth of pine-trees in the German forests.

IV.—SUBTETRAMERA,

In which the tarsi are four-jointed, the third joint being very diminutive and concealed between the lobes of the preceding ones. This section contains a smaller number than any of the former ones. The best-known forms to be met with are the lady-birds. The Common Lady Bird (*Coccinella septem-punctata*) must be familiar to every one. Who has not watched and admired the tiny tidy-shelled little insect, which, when caught, so well for the moment feigns to be quite dead, and draws up its little legs close under its body; then in a moment or two, when it thinks that it is not watched, putting out its small gauzy wings from beneath the wing-cases, and flying away? The larvæ of most of these lady-birds are feeders on plant-lice (Aphides), and are to be constantly found in the summer season upon rose-bushes. Here also comes the now pretty famous Colorado Beetle (*Doryphora septemlineata*), which lives on potatoes. This destructive insect, commonly known as the Colorado Potato-bug, or simply as the Potato-bug, was first described under the scientific name of Doryphora decemlineata, in the year 1824, by Thomas Say, who was then acting as naturalist to Long's Exploring Expedition to the Rocky Mountains. The specimens from which his description was made had been collected in the region of the Upper Missouri, and it was at that time not uncommon there. The original food plant of the beetle was subsequently found to be the Sand-bur (*Solanum rostratum*), a species of wild potato peculiar to the region of the Rocky Mountains.

LADY BIRD.

As civilisation advanced westward, and potatoes began to be grown in its native home, this insect gradually acquired the habit of feeding upon the cultivated potato; and in 1859 it had spread eastward and reached a point one hundred miles to the west of Omaha city, in Nebraska. In 1861 it invaded Iowa, gradually, in the next three or four years, spreading eastward over that State. In 1864 from the eastern borders of North Missouri and Iowa, upon at least five points on a line of two hundred miles. The first published account of the destructive propensities of the species may be found in the *Prairie Farmer* for August 29th, 1861, in a letter from Mr. J. Egerton, of Gravity, Iowa, who stated that "they made their appearance upon the vines as they were up, devouring them as fast as they grew." From that time forth frequent reports of the species' great destructiveness west of the Mississippi appeared in most of the agricultural papers. In October, 1865, Benjamin D. Walsh, of Illinois, furnished to the *Practical Entomologist* an extended description of the new invader from the West, together with an account of its habits so far as they had been investigated; and in the same article expressed the conviction that in all probability it would in future years "travel onwards to the Atlantic, establishing a permanent colony wherever it goes, and pushing eastward at the rate of about fifty miles a year." By the autumn of 1866 the beetle, which appears to have invaded the south-west corner of Wisconsin at as early a date as that of 1862, had already occupied and possessed a very large part of the cultivated and southern portions of that State. In 1867 it had already crossed the eastern borders of Northern and Central Illinois into Western Indiana, and in 1868 it extended to Central

Missouri and Southern Illinois. In 1869 its presence was reported quite generally over the State, and it had even made its way into Ohio, appearing almost simultaneously in the Northern and South-Western portions. During the years 1869 and 1870 the insect was exceedingly destructive all through the North-west, and continued its eastward march at an ever-increasing rate. In July of the latter year it invaded the province of Ontario at two different points, namely, near Point Edward, at the extreme south of Lake Huron, and opposite Detroit, near Windsor, at the south-western corner of Lake St. Clair. During the spring and summer of 1871 the insect was unprecedently numerous. In March of that year the beetle was turned up in great numbers while the ground was being ploughed, especially in fields that had been planted the previous year with late potatoes; and it subsequently swarmed on the wing in the streets of St. Louis.

The northern columns continued to advance at a rapid rate. During the summer the Detroit River was literally swarming with the beetles, and they were crossing Lake Erie on ships, chips, staves, boards, or any other floating object which presented itself. They soon infested all the islands in the west end of the Lake, and by June were common around London, and finally occupied the whole country between St. Clair and Niagara Rivers. In the States they reached in some places the borders of New York and Pennsylvania.

During the year 1876 the insect has swarmed in most of the New England States, and especially on the sea-shore. It has extended north around Montreal, and was especially abundant as far as Trois Rivières; while in its eastern progress it has overrun Connecticut, Massachusetts, Vermont, and New Hampshire, and extended some distance into Maine. At Milestone and other places in Connecticut the beetles were washed ashore in such numbers in September as to poison the air, and the captain of a New London vessel found that they boarded him in such numbers while at sea that the hatches had to be closed. At many watering-places, such as Cape May, Coney Island, Long Branch, Rockaway, and Newport they proved a great nuisance, being crushed and killed in large numbers by the continual promenading along the beach. The *New York Times* reported their impeding the progress of a train on the Central Railroad at Grinnell Station:—"The rails were covered with them for a mile, and after a few revolutions of the drivers the wheels lost the friction and slipped as if oiled; they had to be swept off and the track sanded before any progress was made."

THE COLORADO BEETLE (*Doryphora Septemlineata*).

ORDER IV.—HYMENOPTERA.

The insects of this order are distinguished by the possession of four naked membranous wings. The hind wings are smaller than the fore wings, and have at their anterior margin, nearly in the middle, a row of stiff hooklets, by which these wings are securely fastened to the posterior margin of the front pair of wings. The veins in the wings are of great use in deciding the genera in this order. Some few are wingless. The mouth is furnished with a pair of strong nippers (mandibles), which serve for gnawing, carrying burdens, &c. In some the parts of the mouth are formed for sucking. There are three simple eyes in addition to the compound pair. The abdomen of the female is always terminated by a sting or a borer for laying its eggs. Long ago Aristotle remarked that "the two-winged insects (flies), are distinguished by a sting in front, the four-winged by a sting behind. The first-named in order to feed, the latter in order to defend or avenge themselves."

These insects undergo a perfect metamorphosis. The larvæ of most species are worm-like and without feet; in some species, however, the larvæ have six horny feet; still other larvæ have membranous feet. The larger number of these feet (from twelve to sixteen) distinguishes them from the caterpillars or larvæ of butterflies, which in other respects they resemble. The food of the larvæ is various; the perfect insect feeds especially on the juices of plants, or swallows the honey of flowers. Many species also attack other insects, and thus appear to live on prey; this prey, however, does not serve for their own nutriment, but for that of the larvæ; they are the females that bear it to their nest. The Hymenoptera on the whole do not live longer than a year, from the egg to the last change. Many, as the ants, wasps, and bees, live socially together in large bodies, and form a regulated society.

This order does not contain any particularly large species, although in the mean they are somewhat larger than the Diptera. Only a few species are bright coloured; the colours most frequently occurring are brown, black, and yellow. The species are uncommonly numerous, so that in this respect the order of Hymenoptera is perhaps inferior to the Coleoptera alone. Most of them indicate a very remarkable instinct, and many construct their nests artfully. There is one species from which man derives a great and immediate advantage, and which he has transported with himself to different regions of the globe. We mean the honey-bee, of whose history we shall shortly treat in the sequel.

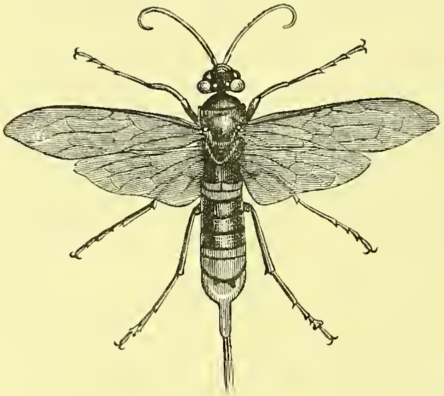
In their metamorphosis these insects correspond with the beetles. In this respect they differ entirely from most of the Neuroptera. Some of them by their larvæ approximate to the Lepidoptera; and some Lepidoptera (Sesia) showa great similarity with Hymenopterous insects. However, beyond doubt, the Hymenoptera have the greatest affinity with the two-winged insects, and we believe that, in a natural arrangement, they can take no other place than in the immediate neighbourhood of these. There are two sub-orders: 1. Securifera, and 2. Peteolata.

I.—SECURIFERA.

In the insects belonging to this sub-order the abdomen is attached to the body by its whole breadth in, as it were, a secure manner. A familiar example is seen in the saw-flies. The larvæ in this sub-order have mostly twenty to twenty-two feet (like caterpillars), feeding on leaves, and proving often very destructive to trees; in some, however, the larvæ have only six legs. The species are generally confined to certain kinds of plants, to which, when they are produced in great numbers, they often do immense mischief. Thus, the larvæ of the Athalia centifolia, known to farmers as the nigger, or black caterpillar, has occasionally done incredible damage to turnips in this country; and that of another species, the Nematus grossularia, is not less destructive to gooseberry bushes. The larvæ of other species infest fruits, living and feeding in the interior, and causing them to fall off whilst still immature. They are almost always furnished with pro-legs in addition to the thoracic members.

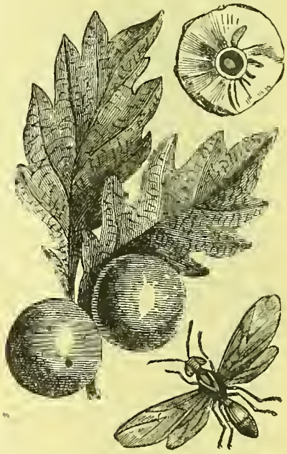
LARVA OF SAW-FLY.

Sirex gigas has the head black, with a large yellow spot on each side behind the eyes; the male with stone-coloured abdomen, the last two rings black; the female has the abdomen at the base and apex yellow, in the middle dull black. This insect is the largest native Hymenopteron. The expanded wings measure two inches two lines, the body one inch two lines, and the borer four lines; but much smaller specimens of the species are met with. The larva lives more than a year in the wood before it changes into a nymph. In summer the insect comes to view from the pupa after three weeks, but when the larva becomes a pupa towards the winter, it continues thus throughout that season.


SIREX GIGAS.

II.—PETEOLATA.

In the second sub-order, the abdomen is connected with the body by means of a slender stalk. The larvæ are more or less maggot-like in form. In one section of the sub-order the ovipositor is exclusively intended for the purpose of egg-laying. This section is called


OAK-GALLS WITH SECTION AND INSECT (*Cynips quercusfoli*) MAGNIFIED.

I.—TEREBRANTIA.

By far the greater number of the species of this section are parasitic upon other insects or on plants, and are popularly known as gall insects and ichneumons. The first tribe, that of the Gallicola, consists almost entirely of vegetable-feeding insects. These are generally of minute size, with straight antennæ, composed of from thirteen to fifteen joints. The wings exhibit only a few nervures, and the palpi are short. Their most striking character consists in the structure of the ovipositor, which is bent into the form of an S within the abdomen, its extremity passing up through a channel formed by the ventral plate of the last abdominal segment. Its construction otherwise departs in no respect from the general character of the order. By means of this ovipositor, which can be exserted or retracted at pleasure, the females puncture the leaves, buds, and other parts of plants and trees, depositing an egg in the wound, accompanied probably by some irritating fluid, which causes a diseased growth in the part, and thus produces the excrescences known as *galls.* Within this domicile the larvæ lives, feeds, and attains its maturity. Here it also undergoes its transformations; and it is not until its arrival at the perfect state that it eats its way out, and becomes a free denizen of the air.

ICHNEUMON.

The second tribe includes an immense assemblage of insects—some of considerable, others of minute size—which, from their constant habit of passing their larvæ state as parasites upon other insects, have received the name of Entomophaga. They are distinguished from the Gallicola by having the ovipositor of the usual construction, straight, and inserted at the apex of the abdomen. It is sometimes concealed, sometimes more or less exserted, and in the latter case often attains a great length. When exserted, the ovipositor appears to consist of three bristles. Of these the outer pair are the terminations of the sheaths, and the middle one is composed of three bristles, forming a minute tube for the passage of the egg.

Insects of every order, and in every stage of their existence, are subject to the attacks of these parasites, which are well known under the name of ichneumons and cuckoo-flies. They introduce their eggs into the bodies of their victims by piercing them with their ovipositor. Minute size is no protection; for many species lay their eggs in aphides, cocci, and the larva of other small insects. The ichneumons, with long ovipositors, seek the burrows of wood-boring insects, whose larvæ they are enabled to reach by means of this organ. Each species usually infests a particular species of insect; and, singular as it may appear, many of these parasitic larvæ are again preyed upon by others, whose parents are directed by an unerring instinct to the selection of the proper position for the nourishment of their offspring.

ANTS' NEST.

Many of them, and especially the larger species, only lay a single egg in their victim; but the larvæ of many of the smaller species exist in families of a hundred, or even more, in the bodies of caterpillars and other insects. The insect infested often acquires the pupa form before any signs of its internal enemies are perceptible; and many a collector of Lepidoptera has been grievously annoyed, when his carefully-preserved chrysalides have produced, as Madame Merian expresses it, nothing but these "little rascally flies." In other cases, generally when a number of these parasitic larvæ have made a common prey of some unfortunate insect, the parasites break out before undergoing their transformation, which then takes place in the interior of a little cocoon, which each of them weaves for itself. This may often be observed in the caterpillars of the common cabbage butterflies.

II.—ACULEATA.

In this second section, the ovipositor not only serves for the depositing of the eggs, but also can inflict a wound, and convey into it an acrid and poisonous fluid, so that it is well called a sting. We can only allude to an example of each of the four large tribes into which this sub-section has been divided, viz., the True Ants, Sand Wasps, True Wasps, and Bees.

The True Ants (*Formica*) live socially, construct for themselves nests of earth, leaves, straw, &c., in which other insects and their larvæ often reside, as those of Cetonia and other Coleoptera, especially Brachelytra, which in these last times has given occasion to much inquiry among entomologists. Above the place where they dwell, the ants raise small hillocks or round heaps of earth. Other species live in hollow stems of trees. Along straight roads over the ground, often a hundred feet long, which all end like rays at the dwelling, the ants pass to and fro; irregular and tortuous passages lead to the separate habitation of the future generation. All the labour of building, of nursing and feeding the larvæ, &c., is discharged by the neuters. They live on fruits, insects and their larvæ, or dead birds and small mammals. They are very fond of sugar, and follow the plant-lice in order to swallow the sweet sap (the honey-dew) that falls from their bodies. They lay up no provision for winter, as far at least as relates to our native species, but pass the winter in a state of torpor, taking no food at all in the severest cold. The working ants bear the larvæ and nymphs with the greatest care between their jaws to the surface when the sun shines on their dwelling, and down again when the rain falls on the earth; and they defend with incredible courage the commonwealth, which has no other government but a true republic. The larvæ and pupæ are commonly taken for eggs by the uninformed, and serve for food for certain singing-birds in cages; nightingales especially are fond of them. In the last days of summer (August), in warm clear weather, the winged males and females leave the nest in which they have been brought up, fly in swarms through the air, copulate, and die soon afterwards, being swallowed by birds, or drowned in water and made food for fishes. The females that are left divest themselves with their feet of the wings that are now useless, and found a new colony. Working ants, in whose neighbourhood they chance to be, drag them to their nest to lay their eggs there. This species affords the formic acid, a secretion from glands in the abdomen of the females and neuters. This acid is constantly fluid, colourless, of a pungent smell, and sharp taste. Fourcroy and Vanquelin were of opinion that it consists of a mixture of acetic and malic acid, but the experiments of Gehlen and others have shown that it is a peculiar acid.

COMMON WASP.
(*Vespa vulgaris*.)

A common species (*Formica rufescens*) robs the nests of other species of ants of the larvæ and pupæ of neuters, and carries them to its nest, where they are brought up with the young of their robber by neuters which have proceeded from larvæ and pupæ stolen at an earlier period. These ant-nests are thus inhabited by two different species, one of which alone works. They are the Amazon-ants of Huber, whose observations have been confirmed by Latreille and by Hanhart.

The Burrowing, or Sand Wasps, consist principally of species of the genus Sphex. The females and most of the species dig in the ground nests for their young, and lay in these holes, near their eggs, insects or larvæ, sometimes spiders, as food for their larvæ when they leave the egg. The larvæ have no feet, resemble maggots, and spin themselves in, before changing into pupæ. The perfect insect is usually very lively, and sucks with avidity the honey-sap of flowers, on which (especially on the Umbelliferæ) it is frequently met with. In many the lower jaws and under lip are prolonged, and form a rostrum; the ligula, however, is not filiform, but commonly has a broad termination. These insects are mostly coloured black, with yellow spots and stripes. The anterior part of the head is beset with fine smooth hairs that often have a beautiful silvery or golden lustre. They lay their eggs in holes, which they excavate with their fore-feet, and place near them a provision of food (insects or spiders—every species appears to select by preference a definite kind), which they drag in either with their jaws or their hind feet.

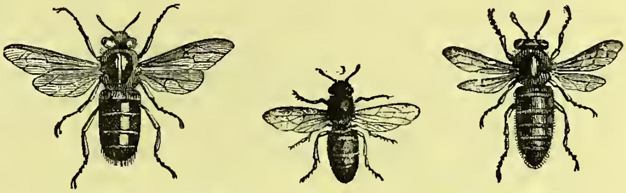
In the True Wasps (*Vespa*), the inner edge of the upper wings is turned down so that their upper surface lies on the under wings; hence the name Diploptera (double-winged), which Kirby, because the termination ptera denotes the names of orders of insects, changed into Diplopteryga.

They are mostly coloured yellow, or red and black. The pupæ are vermiform, and without feet. They are enclosed in separate cells, where they find food placed by the mother with the egg she has laid, or are fed daily by the mother or by the sterile working-wasps.

In the Bees (*Apis*), the wings are constantly veined. The larvæ have a quantity of food, sufficient for the entire state, laid near the egg by the mother, or are provided with it daily by the sexless nurses. The latter is the case wlth those which live in society. The sting here takes the place of the ovipositor of other insects. It is connected with an apparatus for the secretion of poison, which in the bee consists of two long blind tortuous tubes, which coalesce at an acute angle to form a single tube that expands into an oval bladder. From this bladder a fluid passes into the sting, just as from the excretory duct of the poison-gland of the vipcr into the hollow tooth. The sting consists of a pointed case, grooved on the ventral surface, in which groove two fine *spiculæ* drawn to a point are placed. At the extremities these *spiculæ* are provided with sharp teeth, having their points or barbs reverted, which are less powerfully developed in the female (amongst bees, in the queen) than in the sexless individvals, the working bees; also in the former the sting is longer and turned upwards; hollow on the ventral surface. Certain horny plates cover the base of the sting. In the males these parts are wanting. The larvæ live on the pollen and honey of flowers. Most of the species unite for a time, or for the duration of their life, to form a large community. When the society is for life, there are constantly many sexless individuals, whose business it is to construct the nest, and to feed the larvæ uninterruptedly.

Referring to the Cashmere Bee (*Apis Indica ?*), Mr. Moorcraft, the traveller, tells us, "Every farmer in Cashmere has several bee-hives in his house, and in some houses I have counted as many as ten. A provision is made for these in building the house, by leaving appropriate cavities in the walls, which sometimes differ in size, but agree in their general form, each being cylindrical, and extending quite through the wall. The tube thus formed is lined by a plastering of clay mortar, about an inch in thickness, and the mortar is worked up with the chaff or husk of rice, or with the down of thistles, which latter is employed also for clay mortar in general, being the first application of this substance to the use of man which I have yet witnessed. The dimensions of a hive are, on an average, about fourteen inches in diameter, and, when closed at both ends, about twenty or twenty-two inches in length. That end of the cylinder nearest the apartment is closed by a round platter of red pottery-ware, a little convex in the middle, but with the edges made flush with the wall by a luting of clay mortar; and the other extremity is shut by a similar dish, having a circular hole about a third of an inch in diameter in its centre. It does not appear that there is any particular rule for the height of these hives from the ground, as they are sometimes confined to the walls of the lower or basement storey, generally appropriated to cattle, in the farm-houses of Cashmere; at others, are inserted into those of the first floor, and are frequently seen in both situations in the same house, as well as in the walls of its outbuildings. So little difference exists betwixt the practices ordinarily pursued in Cashmere and in Europe, in respect to hiving new swarms, as not to call for notice; but that adopted here for preserving the old swarm, when the honey is taken, well deserves imitation by other bee-farmers. Although the season for taking the honey had passed when I visited Cashmere in the beginning of November, the cottagers indulged my wish of seeing the process by which this was effccted, with little injury to the bees, and with perfect safety to the individual concerned in its management, and which was as follows:—Having in readiness a wisp of dry rice-straw, and a small quantity of burning charcoal in an earthen dish, the master of the house, with a few strokes of the point of a sickle, disengaged the inner platter of the tube, bringing into view the combs suspended from the roof of the hive, and almost wholly covered with bees, none of which, however, offered to resent the aggression, or to enter the room. Having placed the straw upon the charcoal, and holding the dish close to the mouth of the hive, he blew the smoke strongly against the combs, but removed the straw the instant it took fire, to prevent it burning the bees, and quenched the flamc before he employed it again. Almost stifled by the smoke. the bees hurried through the outer door with such rapidity that the hive was cleared of its inhabitants within a few minutcs; when the farmer, introducing the sickle, cut down the combs nearest to him, which were received into a dish previously slidden underneath them, and left undisturbed about one-third of the combs, which were almost close to the outer door. He then replaced the inner platter, and brushing off hastily a few bees which clung to the combs, though apparently in a state of stupefaction, threw them out of the house. Observing many other bees lying motionless on the floor of the hive, I inquired whether they were dead or only stupefied, and was answered that they would recover; however, I was not wholly satisfied that this recovery would take place, preparations for continuing my journey at a very early hour on the following morning having unluckily prevented my examining the spot where they had been thrown, until poultry had for some time been feeding near it. The expelled bees returned as soon as the cavity was freed from the smoke, without stinging a single individual; and the whole business was completed within ten minutes, without, as was asserted, any perceptible loss. The honey was light-coloured, and of a taste as pure and sweet as that of Narbonne. It possessed less of the cloying quality generally attending this substance than any other I recollect to have met with; and I could not learn that the farmers had any suspicion of its ever being intoxicating or poisonous, as is the case occasionally with that made by the Bhoura (*Apis initabilis*), or large wild bee, in the northern mountains of Gurwhal, from feeding, as it is reported, on the flower of the monkshood. I was directed more particularly to inquiry upon this subject by having observed this plant in flower in the valley of Runga, a few miles to the eastward of the bee-district, and think it probable that it extends to these mountains. The peasantry of Cashmere are unacquainted with the employment of honey as the basis of a fermented liquor, and eat it raw, or mixed with articles of common food; whilst the most wealthy substitute it for sugar in preserving fruits. It is customary to take the hive every year, and the end of September or beginning of October is found the best season for this operation, a little time still remaining for the bees to add to the portion left for their support during five months. This amounts to about one-third of the whole produce, and would appear to suffice, as swarms seldom die, and the Casherees substitute no other article for food. It is stated that an old swarm yields more honey than a young one, and that families seldom die except from old age. I was informed that it was no uncommon circumstance to preserve the same community for ten or even for fifteen years, but this was held to be of very rare occurrence. In consequence of the bees being thus literally domesticated, they acquire a mildness of conduct far more decided than those of Europe; and it is possible that the confidence thus gained, subduing their natural irascibility, may generate an increase of industry, or, at least, an increase of produce in relation to the number and size of the individuals of each community. It is also clear that the situation of the hive keeps many of the natural enemies of the bees at a distance. The bee of Cashmere is a little smaller than that of Europe, though a little larger than the domesticated bee of Kumaoon and of Gurwhal. The bhoura, the rock-bee of Gurwhal, or the bee of the southern mountains, is, on the other hand, greatly larger than the domesticated bee of Europe, and greatly exceeds it also in the number of individuals in each community, and in the size and weight of its combs. But its honey is sometimes contaminated by an intoxicating quality, and the temper of the insect is so irritable as to be brought into a dangerous activity by a slight show of aggression. The former quality is suspected, upon probable grounds, to be caused by a secretion of the aconite eaten by this bee; and its irritability of disposition to be owing partly to the exposed situation of the combs suspended from the lower surface of a ledge of rock, and partly to the occasional attempts of bears to carry them off. Both these detractions from the merits of this bee are merely the result of localities; and, under due precautions, it is presumed that its irascibility might be so far subdued as to render it just as safe an inhabitant of a wall-hive as the smaller variety of bee. In a portion of the Punjab, near the hills, this bee is also met with; and I have seen the under surface of the principal branches of a large peepul-tree studded with so many colonies, individually of such great strength, as to deter the neighbouring peasantry from attempting to deprive them of their stores, notwithstanding it was conjectured that there were several hundredweight of combs on the tree. The largest of these assemblages of combs, the probable accumulation of several seasons, was of such a size as I think it not prudent to cite; but, from the specimens I have seen of the produce of this bee, I conceive their domestication, if introduced into Europe, would prove a most valuable acquisition to this branch of farming, although I must confess myself unable to devise any safe and easy plan for transporting such a colony."

In our European Bee (*Apis mellifica*), a beehive consists, like this highly-favoured nation, of three estates—kings, lords, and commons. The king of a beehive is, however, always a *queen;* here, only sometimes. The lords are useless, except as perpetuators of the kind, and are called *drones.* At the end of the season, instead of being allowed to riot on the riches of the commonwealth during the winter, they are all put to death in the most summary manner. The commons are called worker-bees, or neuters.

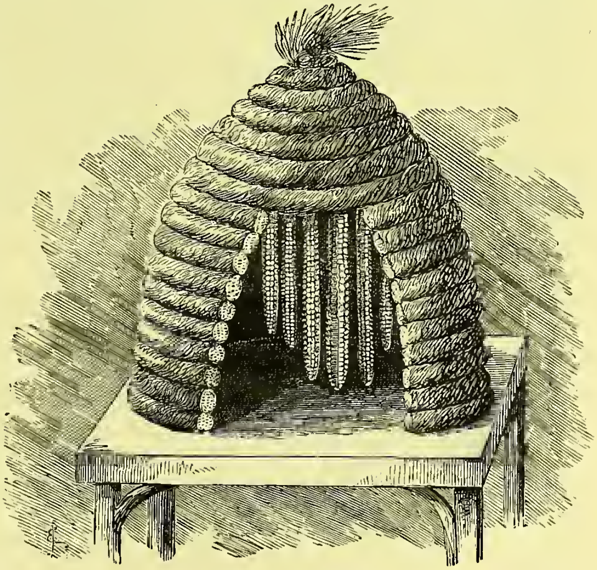

MALE, WORKER, AND FEMALE, OR QUEEN BEE.

The queen is slow and majestic in her movements, and differs from the workers in being larger, having a longer body, shorter wings, and a curved sting. She is accompanied by a guard of twelve workers, who are always on duty. In whatever direction she wishes to travel, these guards clear the way before her, always with the utmost courtesy, turning their faces towards her, and when she rests from her labours, approaching her in all humility, licking her face, mouth, and eyes, and fondling her with their antennæ. The principal engagement of the queen is the laying of eggs. She may be called the mother as well as queen of the hive.

LARVA OF BEE (MAGNIFIED).

The drones are all males; they are less than the queen, but larger than the workers. They have no sting. The drones live on the fat of the land, and are wholly without use as members of the community, except as being the fathers of the future progeny. When this sole office is accomplished, the workers inform them very respectfully that they are no longer wanted; a buzzing and a bustle commences in the hive; the workers and the drones sally forth together, grapple each other in the air, hug and scuffle for a minute, during which the poisonous dagger of the workers is plunged into the side of the drones, who bow down their heads, gather their legs together, and then gracefully drawing their wings as a gauzy mantle around them, hide their face from observation, and so die.

The workers are the smallest bees in the hive, and by far the most numerous. They have a longer lower lip for sucking honey than either of the others; their thighs are furnished with a brush for the reception of the farina of flowers; and their sting is straight. The workers do the entire work of the community: they build the cells, guard the hive and the queen, collect and store the honey, elaborate wax, feed the young, and kill the drones. The respective number of individuals in a full hive are thus, 1 queen, 2,000 drones, and 20,000 workers.


INTERIOR OF BEEHIVE.

The queen lays her eggs one in the bottom of each cell. The egg is long, slightly curved, and of a bluish colour. When laid it is covered with a glutinous matter, which enables it to adhere to the bottom of the cell. For eleven months the queen only lays workers' eggs; after that those which produce drones. As soon as this change has taken place, the workers begin to make royal cells, in which, without discontinuing laying the drones' eggs, she deposits now and then, about once in three days, an egg which is destined to produce a queen. The workers' eggs hatch in a few days, and become little white maggots, which immediately open their mouths to be fed. This the workers attend to with the utmost assiduity. In six days the maggot fills up its cell. It is then roofed in by the workers, spins a silken cocoon, and becomes a chrysalis, and on the twenty-first day it comes forth a perfect bee. The drones emerge on the twenty-fifth day, the queens on the sixteenth.

As we have already stated, the queen, for nearly a year, lays no eggs that are destined to produce queens; it therefore follows that if, during that period, any evil befall her, the hive is left without a queen. Sometimes she dies; sometimes she wanders too near the mouth of the hive, falls out, and a bird devours her; sometimes she is taken away by the experimenting apiarian for the express purpose of watching the result. For twelve hours little notice is taken of the loss; it appears not to be known, and the labourers work as usual. After that period a hubbub commences; work is abandoned; the whole hive is in an uproar; the nation has lost its sovereign, and feels the loss deeply; every bee traverses the hive at random, with the most evident want of purpose. This state of anarchy sometimes continues for days; then the bees gather in knots, clusters of a dozen or so, as though engaged in consultation. Shortly after, a resolution seems to have been made. A few of the workers go to work at the cells in which are the eggs of workers. Three of these cells are quickly broken into one, the edges polished, and the sides smoothed and rounded, a single egg being allowed to remain at the bottom. When this egg hatches, the maggot it produces is fed with a peculiarly nutritive food, called royal bee bread, which is never given to any maggots but such as are to produce queens. Work is now resumed over the whole hive, and goes on as briskly as before. On the sixteenth day the worker's egg produces a queen, whose appearance is hailed with every demonstration of delight, and who at once assumes sovereignty over the hive.

Gentle reader! in the course of thy earthly pilgrimage thou wilt meet with many things that seem at the first glance rather unaccountable, and this is, perhaps, one of those things; but a calm inquiry will relieve our statement of all impossibility, at least. Let us endeavour to explain it. There are, as we have set forth, three kinds of bees in a hive; but there are only two sexes, male and female. Drones are the males; queens and workers are the females, the workers being, for the most part, abortive. That the workers are females, is amply proved by their possessing a sting, and various other anatomical similarities, besides the circumstance of their occasionally laying eggs; and therefore, in the wonderful instance before us, the change is to be attributed solely to the difference of food and care bestowed on the maggot by the workers.

Let us pause an instant and look at this fact in another light. Let us recollect that if each maggot were supplied with a sufficiency of food, and that food sufficiently nutritious, then every female would be a queen. How, then, would the labour of the hive proceed? There would be no cells, no honey stored for the winter, and the whole community would consequently perish.

When, under ordinary circumstances, a young queen emerges from the chrysalis, the old one frequently leaves the hive, heading the first swarm for the season, and flying to some neighbouring resting-place, is observed by the apiator, captured, placed under a new hive, and a new colony is immediately commenced. Before a swarm leaves the hive, sure indications are given of the intended movement. The workers leave their various occupations, and collect in groups, especially near the door of the hive, as though in consultation.

As the summer advances many queens are hatched, but the workers do not allow them instant liberty, as severe battles would immediately take place between them and the reigning queen, in which one would be killed. The workers, therefore, merely make a small hole in the ceiling of the royal cell, through which the captive queen thrusts her tongue, and receives supplies of food from the attentive workers. In this state of confinement the queens utter a low querulous sound, which has been compared to singing. When the reigning, or any other queen that has gained her liberty, finds one of these captives, she uses every effort to tear open the cell and destroy her rival. To prevent this the workers often interpose, pulling her away by the legs and wings. To this she submits but a short time, when, uttering a peculiar cry, called her voice of sovereignty, she commands instant attention and obedience, and is at once freed from her assailants.

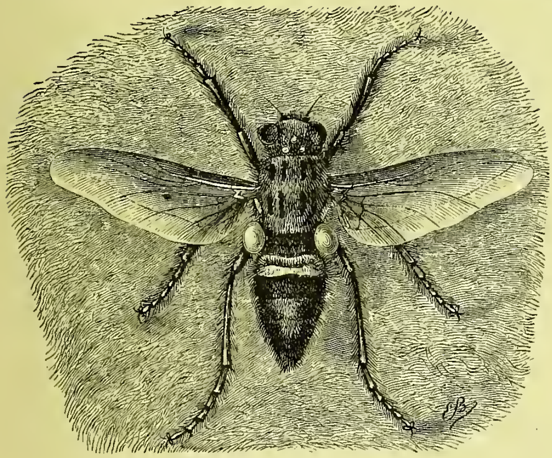
ORDER V.—DIPTERA.

Dipterous insects are provided with two wings, but the second pair are represented by two poisers. They have a suctorial mouth, the lips of which form a proboscis or sheath. This is sometimes composed of three sharp bristle-like organs, which can readily pierce the skin, and so cause the blood to flow. They all undergo a complete metamorphosis. The larvæ, or maggots, have no feet, though they are often provided with small hooks. They live long in the maggot state, and in some few the eggs pass into the larval condition (as in the bluebottle fly) while yet in the body of the mother fly, so that when once laid they can commence to feed. There are the following sections:—

THE HORSE-FLY (*Œstrus equi*).

I.—PUPIPARIA.

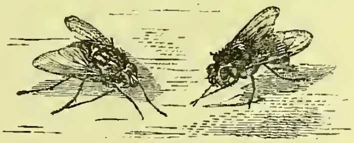
In the flies of this section, the bodies are flat and covered with a hard skin; the feet are short, adapted for crawling; the wings are often quite wanting. They chiefly live on sucking the blood of mammals and birds. The eggs are hatched by the warmth of the body of the parent fly. Almost every bird will be found to have some peculiar species of these flies living on them as parasites. They are often called bird-lice, and frequently greatly torment young birds. The Forest-fly (*Hippobosca equina*) is very troublesome to horses, and the Sheep-tick (*Melophagus ovinus*) is also a well-known species.



THE BOT-FLY (*Œstrus bovis*).

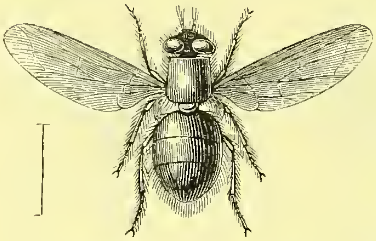
II.—BRACHYCERA.

In this division, to which the house-fly belongs, the antennæ, or feelers, are always very short, and the head is usually as wide as the body. Some of them are known to inflict injuries—indirect ones—on man, such as the horse-bot, which is the larval form living in the stomach of the horse (*Œstrus equi*); and the larvæ of another species (*O. bovis*) lives under the skin of our domestic cattle. The peculiar habits of the flies of this section, however, vary much: the larvæ of the house-fly lives in dung; the common flesh-fly in meat; others in flowers, living on honey; some live in the earth; others surpass the lady-birds in their fondness for plant-lice; some, again, live in the very nests of wasps. Those of the genus Eristalis lives quite happily in foul and dirty water. They have a singular telescopic tail, which they stick up out of the water now and then, and so breathe.



THE HOUSE-FLY (*Musca domestica*).

The species of this section are very numerous. Of those belonging to the genus Musca, we may mention the common House-fly (*Musca domestica*). The larvæ live especially in horse-dung, and these insects are only found in the neighbourhood of human habitations. In a month's time, one generation succeeds another, for the larvæ is full-grown in fourteen days; the fly also, after fourteen days, comes from the pupa, and the egg has only to lie a single day before the young maggot creeps out. Hence it is that they multiply so astonishingly, and that in warm summers, especially at the beginning of autumn, they may prove so numerous. In the open country, and on the roads, various species of fly are met with of the same size, which are usually confounded with them, as Musca corvina, Fabr.; also the unspotted, gold-green glistering Musca cæsar, L. The Blue Flesh-fly (*Musca vomitoria*, L.) has a shining blue abdomen with black stripes, and the head is black with red-brown palps. This fly has a fine sense of smell, and readily penetrates into houses in summer to lay its eggs on meat in kitchens and larders. The same applies to those belonging to the Musca carnaria, L., still larger than the former. It has an abdomen grey with black spots; the antennæ and palps are black. It has been estimated that the progeny of a single female of this species may in one summer amount to more than five hundred millions of flies.



THE BLUEBOTTLE (*Musca vomitoria*).

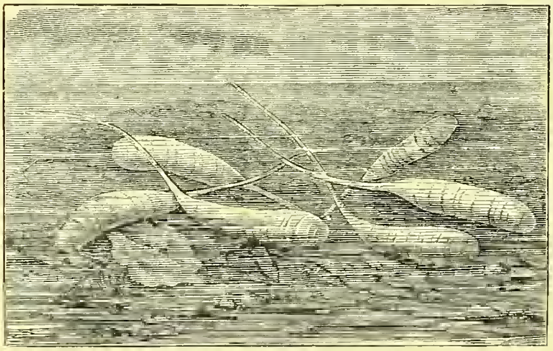
The genus Tachina is a numerous one, which beyond any other gives us an idea of the inexhaustible riches of nature in the forms and modifications of animal organisation. Meigen counts more than three hundred species which are found in Europe, and of the foreign species, yet known so fragmentarily, still more than a hundred have been described. The larvæ of these flies live parasitically in other insects, many species in caterpillars, and they, with the ichneumons, are most serviceable in preserving a balance in the economy of nature, by restraining the excessive multiplication of noxious insects.

The female of Oxybelus uniglumis, another species, digs for each of her eggs a hole in sandy ground, and deposits near it some flies, her booty. In this work she is watched and followed by Miltogramma conica, which lurks near the entrance of the hole for an opportunity to slip in with her as she enters, and to fix some young larvæ on the booty, which afterwards penetrate from it into the larva of the Oxybelus. The reason why the Oxybelus does not drag this Miltogramma itself into the hole as food for the larva of her egg, is readily explained by this insect being viviparous, for then she would have drawn in the Trojan horse.

A SPECIES OF SYRPHUS.

The Syrphi form a pretty family of flies, mostly adorned with yellow transverse bands. They are often to be seen hovering in the air in the same place, moving their wings with very rapid vibrations, and producing a peculiar hum in a high note. Their larvæ, conical and pointed forwards, feed on plant-lice.

Helophilus tenax, L., is very common with us towards autumn, and often mistaken by the uninformed for a bee or a wasp. The larva leaves its hiding-place in August and September to undergo its metamorphosis in chinks of walls. The body of the larva of this and other species ends with a long tail; hence the French name, *Vers à queue de rat.* They live in cavities of the stems of trees in which water is collected, in cesspools and necessaries, and breathe by this tail.

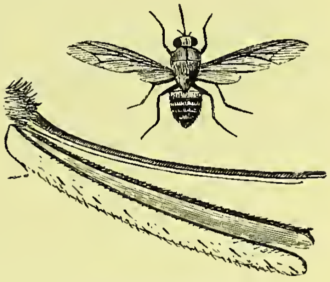


LARVA OF HELIOPHILUS (MUSCA) TENAX.

The Tsetse (*Glossina morsitans*), Livingstone tells us, "is not much larger than the common house-fly, and is nearly of the same brown colour as the common honey-bee. The after-part of the body has three or four yellow bars across it; the wings project beyond this part considerably, and it is remarkably alert, avoiding most dexterously all attempts to capture it with the hand at common temperatures. In the cool of the mornings and evenings it is less agile. Its peculiar buzz when once heard can never be forgotten by the traveller whose means of locomotion are domestic animals, for it is well known that the bite of this poisonous insect is certain death to the ox, horse, and dog. In this journey—though we were not aware of any great number having at any time lighted on our cattle—we lost forty-three fine oxen by its bite. We watched the animals carefully, and believe that not a score of flies were ever upon them.

"A most remarkable feature in the bite of the tsetse is its perfect harmlessness in man and wild animals, and even calves, so long as they continue to suck the cows. We never experienced the slightest injury from them ourselves, personally, although we lived two months in their habitat, which was in this case as sharply defined as in many others, for the south bank of the Chobe was infested by them, and the northern bank, where our cattle were placed—only fifty yards distant—contained not a single specimen. This was the more remarkable, as we often saw natives carrying over raw meat to the opposite bank with many tsetse settled upon it.

"The poison does not seem to be injected by a sting, or by ova placed beneath the skin, for when one is allowed to feed freely on the hand, it is seen to insert the middle prong of three portions, into which the proboscis divides, somewhat deeply into the true skin; it then draws it out a little way, and it assumes a crimson colour as the mandibles come into brisk operation. The previously shrunken belly swells out, and if left undisturbed, the fly quietly departs when it is full. A slight itching irritation follows, but not more than in the bite of a mosquito. In the ox this same bite produces no more immediate effects than in man. It does not startle him as the gad-fly does, but in a few days afterwards the following symptoms supervene:—The eyes and nose begin to run, the coat stares as if the animal were cold, a swelling appears under the jaw, and sometimes at the navel; and though the animal continues to graze, emaciation commences, accompanied with a peculiar flaccidity of the muscles, and this proceeds unchecked until, perhaps months afterwards, purging comes on, and the animal, no longer able to graze, perishes in a state of extreme exhaustion. Those which are in good condition often perish soon after the bite is inflicted with staggering and blindness, as if the brain were affected by it. Sudden changes of temperature produced by falls of rain seems to hasten the progress of the complaint; but in general the emaciation goes on for months, and do what we will, the poor animals perish miserably.


THE TSETSE (*Glossina morsitans*).

"When opened, the cellular tissue on the surface of the body beneath the skin is seen to be injected with air, as if a quantity of soap-bubbles were scattered over it, or a dishonest, awkward butcher had been trying to make it look fat. The fat is of a greenish-yellow colour, and of an oily consistence. All the muscles are flabby, and the heart often so soft that the fingers may be made to meet through it. The lungs and liver partake of the disease; the stomach and bowels are pale and empty, and the gall-bladder is distended with bile.

"These symptoms seem to indicate what is probably the case—a poison in the blood, the germ of which enters when the proboscis is inserted to draw blood. The poison-germ, contained in a bulb at the root of the proboscis, seems capable, although very minute in quantity, of reproducing itself, for the blood, after death by tsetse, is very small in quantity, and scarcely stains the hands in dissection.

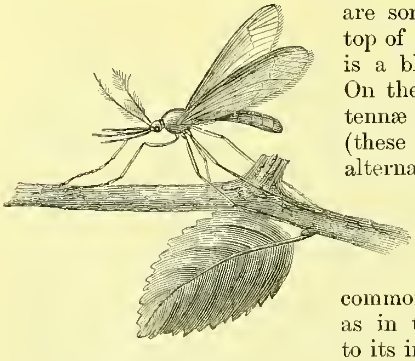
"The mule, ass, and goat enjoy the same immunity from the tsetse as man and the game. Many large tribes on the Zambesi can keep no domestic animals except the goat, in consequence of the scourge existing in their country. Our children were frequently bitten, yet suffered no harm; and we saw around us numbers of zebras, buffaloes, pigs, pallahs, and other antelopes, feeding quietly in the very habitat of the tsetse, yet as undisturbed by its bite as oxen are when they first receive the fatal poison. There is not so much difference in the natures of the horse and zebra, the buffalo and ox, the sheep and antelope, as to afford any satisfactory explanation of the phenomenon. Is a man not as much a domestic animal as a dog? A curious feature in the case is that dogs perish though fed on milk, whereas the calves escape so long as they continue sucking, made us imagine that the mischief might be produced by some plant in the locality, and not by tsetse; but Major Vardon, of the Madras Army, settled that point by riding a horse up to a small hill infested by the insect without allowing him time to graze, and, though he only remained long enough to take a view of the country and catch some tsetse on the animal, in ten days afterwards the horse was dead.

"The well-known disgust which the tsetse shows to animal excreta, as exhibited when a village is placed in its habitat, has been observed and turned to account by some of the doctors. They mix droppings of animals, human milk, and some medicines together, and smear the animals that are about to pass through a tsetse district; but this, though it proves a preventive at the time, is not permanent. There is no cure yet known for the disease. A careless herdsman allowing a large number of cattle to wander into a tsetse district loses all but the calves; and Sebitnane once lost nearly the entire cattle of his tribe—very many thousands—by unwittingly coming under its influence. Inoculation does not insure immunity, as animals which have been slightly bitten in one year may perish by a greater number of bites in the next; but it is probable that with the increase of guns the game will perish, as has happened in the south, and the tsetse, deprived of food, may become extinct simultaneously with the larger animals."

III.—NEMOCERA.

In this division the antennæ are long, with numerous joints, often as many as sixteen, so that they look like little plumes. The head is small. Many, especially the smaller species, fly in great troops dancing through the air. The females lay their eggs on the water, some on plants, or on the ground. The larvæ are long and vermiform; their body has twelve rings, besides the clearly distinct horny head. The head is provided with manducating oral organs. The stigmata are various in number and position. The larvæ constantly cast their skin before changing to pupæ. In the pupa the parts of the insect may be clearly recognised. Almost always these pupæ lie uncovered in the water or under the ground; only in some instances are they enclosed in a case or web. Many of the pupæ are provided with spines or horns, by means of which, about the time of the last changing, they are able to work to the surface of the earth.

The larvæ of many species live in excrescences of plants, like the gall-wasps. By such an insect those excrescences also are caused which are sometimes seen in the form of double roses on the top of willow-branches. The larva of Tipula plumosa, L., is a blood-red worm, often met with in rain reservoirs. On the head are two black eye-spots, and two short antennæ consisting of one joint and two threads at the point (these are wanting in Réaumur's figure). The head is alternately drawn into and pushed out at the next following joint by the larva. The eggs of Chironomus, oval or navicular, and united by strings, were formerly taken for minute plants.


THE GNAT (*Culex pipiens*).

The Gnat (*Culex pipiens*) is everywhere very common, especially in the neighbourhood of turf-diggings, as in the province of Holland. Its hum or song adds to its inconvenience. The females alone sting; the males, known by their plumed antennæ, little or not at all. The larvæ live in water, and hang on the surface to breathe, with head downwards. On the back, at the ninth ring of the abdomen, there is a tube for respiration. These larvæ swim expeditiously, change their skin a few times, and become pupæ, which also move sinuously, but do not eat, and advance in the water head upwards, it being kept in this position by two little tubes or horns that stand above the thorax and serve for respiration. On the last metamorphosis the skin splits between the tubes, and the perfect insect creeps into view through the opening thus effected. It drifts for a time on the cast-off skin as on a little boat until its wings are strong enough, when the gnat leaves the water. These metamorphoses occur within a period of three or four weeks. Another species, with black-spotted wings and white-ringed feet (*Culex annulatus*), is often to be met with in winter and in the first days of mild weather, in dwellings.

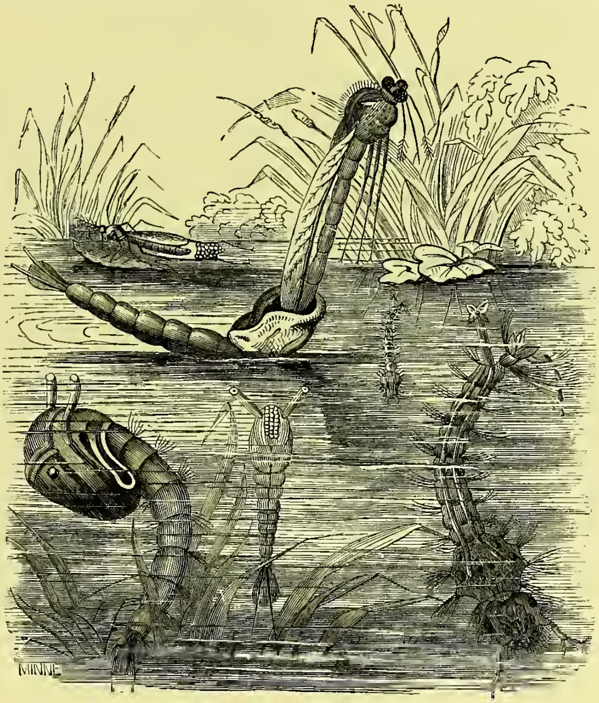
Mr. Lord, referring to mosquitoes, thus describes the insect pests in Vancouver's Land:—

"Reader, if you have never been in British Columbia, then, I say, you do not know anything about insect persecution; neither can you form the faintest idea of the terrible suffering foes so seemingly insignificant as the bloodthirsty Horse-fly (*Tabanus*), the tiny burning fly, and the well-known and hated mosquito, are capable of inflicting.

"A wanderer from my boyhood, I have met with these pests in various parts of our globe—in the country of Cyernomoryi, among the Black Sea Cossacks, on the plains of Troy, upon Mount Olympus, amidst the gorgeous growths of a tropical forest, where beauty and malaria, twin brothers, walk hand-in-hand—away in the deep dismal solitudes of the swamps on the banks of the Mississippi, on the wide grassy tracks of the Western prairies, and on the snow-clad summits of the Rocky Mountains.

"Widely remote and singularly opposite as to climate as are these varied localities, yet, as these pests are there in legions, I imagined that I had endured the maximum of misery they were capable of producing. I was mistaken; all my experience, all my vaunted knowledge of their numbers, all I had seen and suffered, was as nothing to what I subsequently endured. On the Sumass prairie, and along the banks of the Fraser river, the mosquitoes are, as a Yankee would say, "a caution."

"In the summer, our work, that of cutting the boundary-line, was along the low and comparatively flat land intervening between the seaboard and the foot of the Cascade Mountains. Our camp was on the Sumass prairie, and was in reality only an open patch of grassy land, through which wind numerous streams from the mountains, emptying themselves into a large shallow lake, the exit of which is into the Fraser by a short stream, the Sumass river.



METAMORPHOSIS OF A GNAT.

"In May and June this prairie is completely covered with water. The Sumass river, from the rapid rise of the Fraser, reverses its course, and flows back into the lake instead of out of it. The lake fills, overflows, and completely floods the lower lands. On the subsidence of the waters, we pitched our tents on the edge of a lovely stream. Wild fowl were in abundance; the streams were alive with fish; the mules and horses revelling in grass knee deep—we were in a second Eden.

"We had enjoyed about a week in this delightful camp, when the mosquitoes began to get rather troublesome. We knew these most unwelcome visitors were to be expected, from Indian information. I must confess I had a vague suspicion that the pests were to be more dreaded than we were willing to believe; for the crafty red-skins had stages erected, or rather fastened to stout poles driven into the bottom of the lake. To these large platforms over the water they all retire on the first appearance of the mosquitoes.

"In about four or five days the increase was something beyond all belief, and really terrible. I can convey no idea of the numbers, except by saying they were in dense clouds; truly, and not figuratively, a thick fog of mosquitoes. Night or day it was just the same;

the hum of these bloodthirsty tyrants was incessant. We ate them, drank them, breathed them; nothing but the very thickest leathern clothing was of the slighest use as a protection against their lancets. The trousers had to be tied tightly round the ankle, and the coat-sleeve round the wrist, to prevent their getting in; but if one more crafty then the others found out a needle-hole, or a thin spot, it would have your blood in a second. We lighted huge fires, fumigated the tents, tried every experiment we could think of, but all in vain. They seemed to be quite happy in a smoke that would stifle anything mortal, and, what was worse, they grew thicker every day.

"Human endurance has its limits. A man cannot stand being eaten alive. It was utterly impossible to work; one's whole time was occupied in slapping viciously at face, head, and body, stamping, grumbling, and savagely slaughtering hecatombs of mosquitoes. Faces rapidly assumed an irregularity of outline anything but consonant with the strict lines of beauty; each one looked as if he had gone in for a heavy fight, and lost. Hands increased in size with *painful* rapidity, and—without intending a slang joke—one was in a *k-nobby* state from head to heel.

"The wretched mules and horses were driven wild, racing about like mad animals, dashing into the water and out again, in among the trees; but, go where they would, their persecutors stuck to them in swarms. The poor dogs sat and howled piteously, and, prompted by a wise instinct to avoid their enemies, dug deep holes in the earth, and, backing in, lay with their heads at the entrance, whining, snapping, and shaking their ears, to prevent the mosquitoes from getting in at them.

"There was no help for it—our camp had to be abandoned. We were completely vanquished and driven away—the work of about a hundred men stopped by tiny flies. Our only chance of escape was to retire into the hills, and return to complete our work late in the autumn, when they disappear. Hard wind is the only thing that quells them; but they return on its lulling, if possible, more savagely hungry.

"One thing has always puzzled me in the history of these ravenous cannibals. What on earth can they get to feed on when there are no men or animals? I brought home specimens, of course, and I am by no means sure I feel any great pleasure in finding my foe to be a new species, but it is, and named Culex pinguis, because it was fatter and rounder than any of its known brethren.

"The habits of this new mosquito are in every detail the same as all the known species. The female lays her eggs, which are long and oval in shape, in the water; then, aided by her hind-legs, she twists about the eggs, and tightly glues them together into a very beautiful little boat-shaped bundle, that floats and drifts about in the water. In sunny weather the eggs are speedily hatched, and the larvæ lead an aquatic life. They are very active, diving to the bottom with great rapidity, and as quickly ascending to the surface to breathe. The respiratory organs being situated near the tail, on the eighth segment of the abdomen, they hang as it were in the water head downwards. After shifting the skin three or four times they change into the pupa form, in which state they move about even more actively than before, aided by the tail and two organs like paddles attached to it. In this stage of their existence they never feed (I only wish they would always remain in this harmless condition), and although they still suspend themselves in the water the position is reversed, the breathing organs being now placed on the chest.

"The final change to the perfect or winged state is most curious, and well worth careful attention. The pupa-case splits from end to end, and looking moist and miserable, with crumpled wings, the little fly floats on its previous home, an exquisite canoe of Nature's own contriving. A breeze of wind sufficient to ripple the water is fatal to it now, as shipwreck is inevitable; but if all is calm and conducive to safety the little fly dries, the wings expand, it inhales the air, and along with it strength and power to fly; then bidding good-bye to the frail bark, wings its way to the land, and begins a war of persecution.

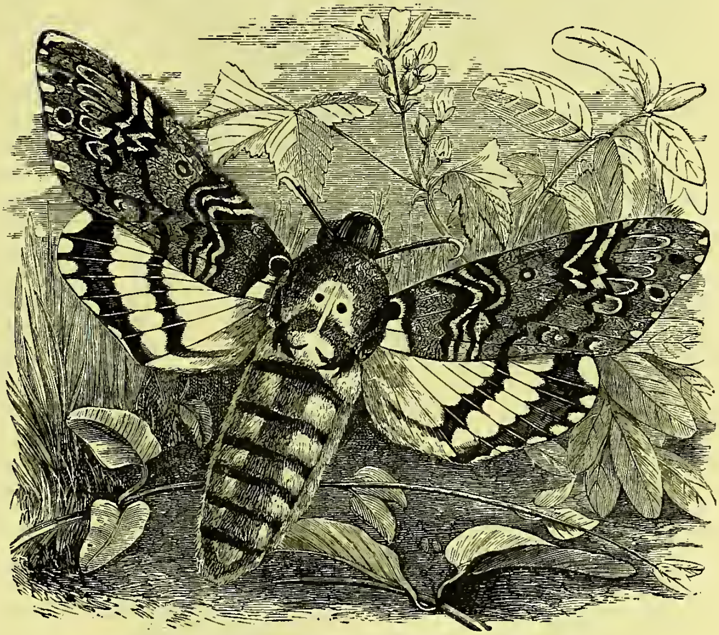
"Mosquitoes never venture far over the water after once quitting their skin canoe. This fact the wily savage has taken advantage of. During the 'reign of terror' the Indians never come on shore if they can help it, and if they do they take good care to flog every intruder out of the canoes before reaching the stage."

ORDER VI.—LEPIDOPTERA.

The insects belonging to this order are amongst the largest, the brightest-coloured, and the best known of the class. They have six legs, four membranous wings covered over with minute, variously-coloured scales (λεπις, scale, and πτερον, wing). The mouth is furnished with a curiously coiled-up spiral tongue. Their metamorphosis is complete. In the larval stage (caterpillar) they are very ravenous, feeding on green leaves, and often do a great deal of harm; but after they escape from the chrysalis stage and become winged imagos, they feed entirely on the nectar of flowers.

The scales which cover the surface of their wings are, to the unassisted eye, like fine dust, but are seen to be, with the assistance of a lens, arranged on the wings like tiles on a roof. In some species spots on the wings will be left bare of these scales, and then these places will look like transparent eyes. In some few the females want wings, or have these developed in a very rudimentary manner, as in the silkworm.

The caterpillars change their skin four or five times before changing into the pupa or chrysalis condition. A few feed on leather, fur, &c., but most of them are vegetarians. In some, the pupæ will be enclosed in a cocoon. This in the case of the silkworm moth consists of fine silk, but often the cocoon will be formed of foreign substances fastened together by silken threads.



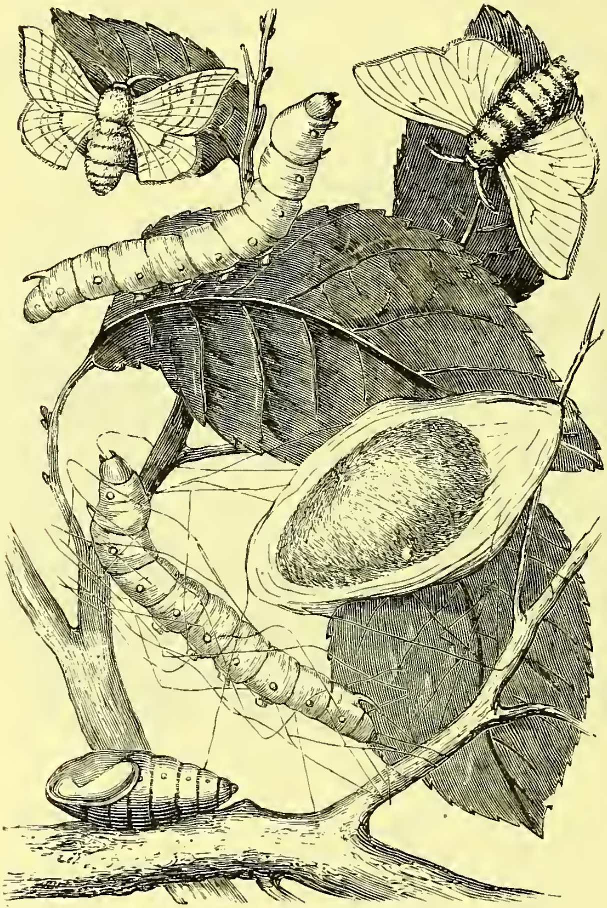
THE DEATH'S HEAD HAWK-MOTH (*Acherontia atropos*).

This order divides itself into the two very natural sub-orders, the Moths and the Butterflies.

SUB-ORDER I.—HETEROCERA.

The Moths are chiefly night-flying (nocturnal) Lepidoptera; the feelers, or antennæ, are plume-like in the males; the wings are, with a few exceptions, folded on the back. The females of some are wingless. Most of the caterpillars spin a cocoon. There are, at least, the following fifteen families of this sub-order, each with numerous species:—1. Sphingidæ; 2. Uraniidæ; 3. Anthroceridæ; 4. Ægeridæ; 5. Hepialidæ; 6. Bombycidæ; 7. Arctiidæ; 8. Lithosiidæ; 9. Noctuidæ; 10. Geometridæ; 11. Pyralidæ; 12. Tortricidæ; 13. Yponomeutidæ; 14. Tineidæ; and 15. Alucitidæ.

The family of the Sphingidæ embraces some of the largest European Lepidoptera: among others may be mentioned the Death's Head Hawk-Moth (*Acherontia atropos*), an insect not uncommon in some parts of England, and which measures from tip to tip of the expanded wings usually a trifle less than five inches. Its general colour is dark, the superior wings being mottled with brown, black, and yellow; the body is yellow, has a longitudinal black dorsal mark, and narrow black bands; on the thorax are pale markings, which bear some resemblance to a skull. The larva is of a greenish-yellow colour, with the back speckled with black, and transverse lateral lines partly blue and partly white. It feeds upon the potato plant, jasmine, &c. When full grown the larva measures about five inches in length; and when about to assume the pupa state, it buries itself in the ground. "Towards the end of September or the beginning of October," says Mr. Stephens, "the imago is produced, and, like the rest of the group, flies morning and evening only. The conspicuous patch on the back of its thorax, which has a considerable resemblance to a cranium, or death's head, combined with the feeble cry of the insect, which closely resembles the noise caused by the creaking of a cork more than the plaintive squeaking of a mouse, has caused the insect to be looked upon by superstitious persons as the harbinger of death, disease, and famine, and their sudden appearance in Bretagne, as we are informed by Latreille, during a season while the inhabitants were suffering from an epidemic disease, tended to confirm the notions of the superstitious in that district, and the disease was attributed by them entirely to the visitations of these hapless insects." The death's head moth is at times very troublesome to the keepers of bee-hives, which it robs of the honey.



THE SILKWORM (*Bombyx mori*).

We select one of the most interesting of the Bombycidæ as a type of the others, the Bombyx mori, well known as the moth to which the silkworm turns. This species, which was originally from China, is of a white or cream colour, with a brown fascia and two or more waved lines of a deeper colour crossing the upper wings. In this country the eggs of this moth hatch early in May. The caterpillar, or silkworm, is at first of a dark colour, but soon becomes light, and in its tints much resembles the perfect insect, a circumstance common in caterpillars. Its proper food is the mulberry, though it will likewise eat the lettuce, and some few other plants; on the latter, however, it does not thrive equally well, and the silk yielded is of a poor quality.

The silkworm is about eight weeks in arriving at maturity, during which period it changes its skin four or five times. When about to cast its skin it ceases to eat, raises the fore part of the body slightly, and remains in perfect repose. In this state it is necessary that it should continue for some little time, in order that the new skin, which is at this time forming, may become sufficiently mature to enable the caterpillar to burst through the old one. This operation, which is apparently one of considerable difficulty, is performed thus:—The fore part of the old skin is burst; the silkworm then, by continually writhing its body (but not moving from the spot), contrives to thrust the skin back to the tail, and ultimately to disengage itself altogether. This last part of the operation, however, is the most difficult, since it is no uncommon occurrence for them to die from not being able to disengage the last segment of the body from the old skin.

Those who have reared silkworms must have observed how large the head is in proportion to the body in those which have just changed their skins. This circumstance is worthy of observation, for in it will be found a most beautiful contrivance.

When the larvæ of an insect has just changed its skin, every part is soft, and in many cases (such as caterpillars) the greater portion of the body still remains in this flexible state; but the skin of the head and some few other parts, in all instances, soon become hardened, after which it never grows.

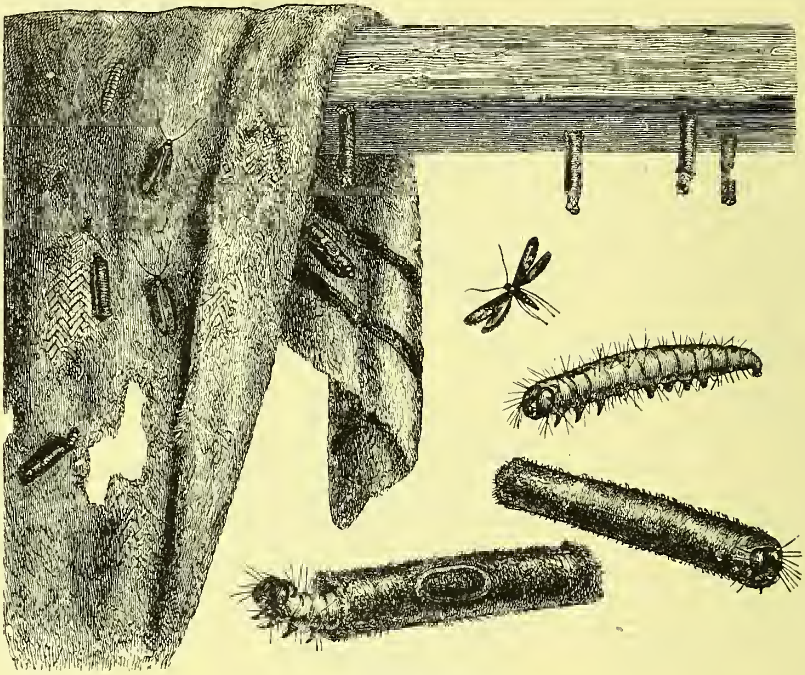
When full grown the silkworm commences spinning its web in some convenient spot, and as it does not change the position of the hinder portion of its body much, but continues drawing its thread from various points and attaching it to others, it follows that after a time its body becomes in a great measure enclosed by the thread. The work is then continued from one thread to another, the silkworm moving its head and spinning in a zigzag way, bending the fore part of the body back to spin in all directions within reach, and shifting the body only to cover with silk the part which is beneath it. As the silkworm spins its web by thus bending the fore part of the body back, and moves the hinder part of the body in such a way only as to enable it to reach the farther back with the fore part, it follows that it encloses itself in a cocoon much shorter than its own body, for after the beginning the whole is continued with the body in a bent position.

During the time of spinning the cocoon, the silkworm decreases in length very considerably, and after it is completed it is not half its original length. At this time it becomes quite torpid, soon changes its skin, and appears in the form of a chrysalis. The time required to complete the cocoon is about five days. In the chrysalis state the animal remains from a fortnight to three weeks; it then bursts its case and comes forth in the imago state, the moth having previously dissolved a portion of the cocoon by means of a fluid which it ejects.

The moth is short-lived; the female, in many instances, dies almost immediately after she has laid her eggs; the male survives her but a short time.

The silkworms, which are most extensively reared for the purpose of producing silk, are liable to many diseases, and none have been more destructive than that called muscardine. This disease attacks the caterpillar when about to enter the chrysalis state. It is always attended with the development within the body of a minute fungus closely resembling our common mould. It is probable the fungus only attacks those worms which are predisposed to disease, but in certain seasons this fungus has been so extensively developed as to lead to the supposition that it produces the disease itself. It is very certain that, when this fungus is prevailing and its spores are introduced into the body of the silkworm, it becomes rapidly diseased and dies. The fungus spreads internally before the death of the worm, and afterwards it shoots forth from the surface of the skin. The chrysalis and moth will have the disease if inoculated with the fungus, but it only occurs spontaneously on the caterpillar.

We find space to allude to another common moth. Mr. Riley tells us "The name clothes-moths is applied to several distinct, but similar, species of minute moths belonging to the family Tineidæ, which, in their larval state, are very destructive to woollen goods, fur, skins, feathers, and similar substances. Among them may be mentioned the Clothes-moth (*Tinea rusticella*), the Carpet-moth (*Tinea tapetryella*), the Fur-moth (*Tinea pellionella*) and the Hair-moth (*Tinea biselliella*). These Tineidæ have slender bodies, and lamellated deeply-fringed wings, that expand six-tenths or eight-tenths of an inch. The antennæ and palpi are short and thread-like, and there is a thick orange or brown tuft on the forehead. The colours range from buff to drab and dark grey. The eggs are laid in May and June (the moth dying immediately afterwards), and hatch out in fifteen days. The young worms at once proceed to work, gnawing the substances within their reach, and covering themselves with the fragments, which they shape into hollow rolls and line with silk. These rolls are by some carried on their backs as they move along, and by others fastened to the substance they are feeding upon, and they are enlarged from time to time by additions to the open extremities, and by portions let into the sides, which are split open for this purpose. In such ambush the worms carry on their work of destruction through the summer, rest in seeming torpor during the winter, and change into chrysalids early in the spring. They transform again in twenty days, and issue from their shelter as winged moths, to fly about in the evening till they have paired, and are ready to lay eggs. Then follows an invasion of dark closets, chests, and drawers, edges of carpets, folds of curtains, and hanging garments; and the foundation of a new colony is swiftly laid. The early days of June should herald vigorous and exterminating warfare against these subtle pests. Closets, wardrobes, and all receptacles for clothing, should be emptied and laid open, their contents thoroughly exposed to light and air, and well brushed and shaken before being replaced. In old houses much infested with moths, all cracks in floors, wainscots, shelves, or furniture should be brushed over with spirits of turpentine. Camphor or tobacco should be placed among all garments, furs, plumes, &c., when laid aside for the summer. To secure cloth linings of carriages from the attacks of moths sponge them on both sides with a solution of corrosive sublimate of mercury in alcohol, made just strong enough not to leave a white mark on a black feather. Moths may be killed by fumigating the article containing them with tobacco or sulphur, or by putting it, if practicable, into an oven heated about 150° Fahrenheit.



THE CLOTHES MOTH.

SUB-ORDER II.—RHOPALOCERA.

The Butterflies are mostly day-flying Lepidoptera. When at rest the wings are mostly carried erect, folded against each other. The feelers (antennæ) are mostly terminated by a little club-shaped body. The caterpillars do not spin a cocoon.

Of this sub-order Mr. Wallace enumerates the following families:—1. Hesperidæ; 2. Papilionidæ; 3. Pieridæ; 4. Lycænidæ; 5. Erycinidæ; 6. Eurygonidæ; 7. Nemeobidæ; 8. Libytheidæ; 9. Nymphalidæ; 10. Heliconidæ; 11. Acræidæ; 12. Brassolidæ Morphidæ; 13. Elymniidæ; 14. Satyridæ; and 15. Danaidæ; and he gives a census of the species, from which we conclude that upwards of 7,770 different butterflies are known.

Of our native species we may mention the Swallow-tail (*Papilio machaon*). Mr. Morris says:—"In all our judgments of objects of natural history, comparison and relative proportion must guide us to the result. Compared, then, with multitudes of the exotic species whose dazzling refulgence, splendid lines, and elegant and wonderfully varied and eccentric markings adorn the hills and valleys of far distant and tropical lands, which these by themselves alone furnish an abundantly exciting wish to visit, the present, our largest British butterfly—our finest capture—holds but a humble place—

'a Satyr to Hyperion,' almost—a fire by their side to beauty. But we must not, and we do not, despise our own swallow-tail.

THE SWALLOW-TAILED BUTTERFLY (*Papilio machaon*).

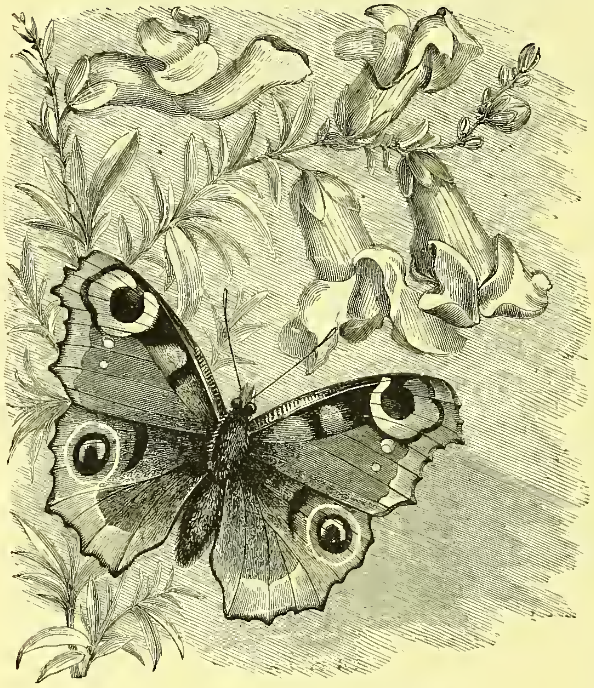
"This fine species is said to be found in various parts of Europe, Asia, and Africa—namely, in the whole of the former continent, even in Siberia; in Syria, Nepaul, Cachemere, and the Himalayan Mountains; Egypt, and the coast of Barbary. In our own country it has been met with in Yorkshire, near Beverley and Cottingham; in Dorsetshire, by J. C. Dale, Esq., in the parish of Glanville's Wootton (he took twelve specimens there in three days, about thirty years ago, but has not seen one since); in Hampshire, Middlesex, Sussex, Essex, and Kent, in Norfolk at Acle, near Yarmouth, in plenty; and also in meadows at Orby and Thurne, in some years in great abundance; but most of all in Cambridgeshire and Huntingdonshire, where, in the fenny districts, it has been, and even is still, very abundant; though, as those parts are fast being drained, it is to be feared that we may in time lose this most conspicuous ornament of our cabinets. The perfect insect is taken from the beginning of May to the end of August. It measures, in different specimens, from three inches to three inches and three-quarters in the expanse of the wings. The caterpillar occurs from June to September. It feeds on various umbelliferous plants, particularly on the marsh parsley (*Selinum palustre*), the wild carrot (*Daucus carota*), and the fennel (*Anethum fœniculum*).

Another lovely species, the Peacock butterfly (*Vanessa Io*), is thus described by the same author:—"As the student in entomology, or, indeed, in any branch of natural history, meets for the first time with one new species after another whose distinctive appearance it had never even come into his mind before to conceive, he repeatedly exclaims—not, indeed, perhaps in the words, but in the admiration of his mind—'Wonders never cease!' Well do I remember the intense pleasure which, when a boy, the first sight of the Peacock, the Red Admiral, and the Brimstone afforded me. I wish others to experience the same gratification, and shall be truly glad if my 'History of British Butterflies' furthers the cause of the gladsome science which it is intended to illustrate. This truly splendid species is common throughout the greater part of the country, though less so as you advance farther north. In the south of Scotland it is but sparingly met with. The perfect insect appears in the middle of July, and by no means unfrequently survives until the following spring, hibernating during the winter in sheltered 'nooks and corners.' In this grand fly the wings expand to the width of from two and a half to three inches; the fore-wings are of a rich dark brownish-red; on their front margin there are two black nearly triangular-shaped marks, the inner one smaller than the other, which latter forms the inside of a large patch, angular on its inner side, and rounded on its outer one, which is, as it were, partially eclipsed by a large eye, whose ground colour is a yellowish buff and within whose orbit are marks of black and purple-red, with a border

LARVA AND CHRYSALIS OF P. MACHAON.

of blue spots, and three pale blue specks, followed by two others outside it. It is much in the form of the handle of 'Charles's Wain,' the always well-known constellation that guides the traveller by showing him unerringly the north, a beacon which, as the church spire points upwards to raise the mind towards heaven for the journey thither, directs by a downward indication the earthly pilgrimage of many a benighted wanderer both by sea and land. 'God is great,' says the Moslem, and verily the Moslem speaks true in his saying. Great He is, in the stars of heaven, those unknown worlds of illimitable space, and great, equally great, in the humble though beautiful insect before us.

"The outer margin of the wings is brown, and their front edge is striated on the inner half with streaks of dark yellowish and black. The hind wings are also reddish-brown on the central and hinder parts of their surface; the base being brown, studded with innumerable specks of yellow dust, and the outside border brown. Near the outer corner is a very large eye surrounded with a colour which approaches more nearly to white than any other, and it is bounded on its inside with blackish-brown. The eye itself is black, with fine blue specks in it—two, two, and one. Underneath, the fore-wings are dark brown, streaked across with an infinity of darker marks, some wider, some narrower, and some of deeper shades than others. The hind wings are of a darker ground-colour than the fore ones, striated in the same way, and across their centre is one large waved bar formed by dark edges, and in its centre an obscure yellowish-white dot. The caterpillar is found in the beginning of July. It feeds on the common nettle. It is gregarious in its habits, black, spined, spotted with white, and the hind legs are red. The chrysalis is indented, of a greenish colour, and dotted with gold."


THE PEACOCK BUTTERFLY (*Papilio Io*).

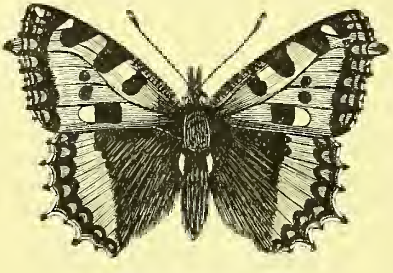
Our space will not permit us to allude to even a tithe of the butterflies known, which we regret the less, because we can refer our readers to Mr. Kirby's beautifully illustrated work now in process of publication on the species of this very sub-order, and we must content ourselves with the following extracts from Mr. Wallace's delightful work on the "Natural History of the Malay Archipelago," in which he thus describes one of the most superb butterflies known:—

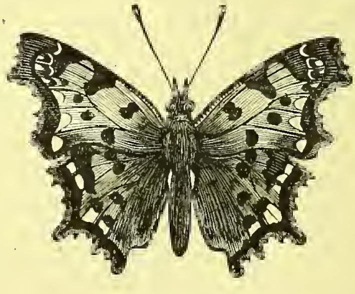
"On our way back in the heat of the day, I had the good fortune to capture three specimens of a fine Ornithoptera, the largest, the most perfect, and the most beautiful of butterflies. I trembled with excitement as I took the first out of my net and found it to be in perfect condition. The ground colour of this superb insect was a rich shining browny-black, the lower wings delicately grained with white, and bordered by a row of large spots of the most brilliant satiny yellow. The body was marked with shaded spots of white, yellow, and fiery orange, while the head and thorax were intense black. On the underside the lower wings were satiny white, with the marginal spots half black and half yellow. I gazed upon my prize with extreme interest, as I at first thought it was quite a new species. It proved, however, to be a variety of Ornithoptera remus, one of the rarest and most remarkable species of this highly esteemed group.

"Another species to which I have to direct attention is the Kallima paralekta, a butterfly of the same family group as our Purple Emperor, and of about the same size, or larger. Its upper surface is of a rich purple, variously tinged with ash-colour, and across the fore-wings there is a broad bar of deep orange, so that when on the wing it is very conspicuous. This species was not uncommon in dry woods and thickets, and I often endeavoured to capture it without success, for after flying a short distance it would enter a bush among dry or dead leaves, and however carefully I crept up to the spot I could never discover it till it would suddenly start out again and then disappear in a similar place. At length I was fortunate enough to see the exact spot where the butterfly settled, and though I lost sight of it for some time, I at length discovered that it was close before my eyes, but that in its position of repose it so closely resembled a dead leaf attached to a twig, as almost certainly to deceive the eye even when gazing full upon it. I captured several specimens on the wing, and was able fully to understand the way in which this wonderful resemblance is produced. The end of the upper wings terminates in a fine point, just as the leaves of many tropical shrubs and trees are pointed, while the lower wings are somewhat more obtuse, and are lengthened out into a short, thick tail. Between these two points there runs a dark curved line exactly representing the midrib of a leaf, and from this radiate on each side a few oblique marks which well imitate the lateral veins. These marks are more clearly seen on the outer portion of the base of the wings, and on the inner side towards the middle and apex, and they are produced by striæ and markings which are very common in allied species, but which are here modified and strengthened so as to imitate more exactly the venation of a leaf. The tint of the under surface varies much, but it is always some ashy-brown or reddish colour, which matches with those of dead leaves. The habit of the species is always to rest on a twig and among dead or dry leaves, and in this position, with the wings closely pressed together, their outline is exactly that of a moderately-sized leaf, slightly curved or shrivelled. The tail of the hind wings forms a perfect stalk, and touches the stick, while the insect is supported by the middle pair of legs, which are not noticed among the twigs and fibres that surround it. The head and antennæ are drawn back between the wings so as to be quite concealed, and there is a little notch hollowed out at the very base of the wings, which allows the head to be retracted sufficiently. All these varied details combine to produce a disguise that is so complete and marvellous as to astonish every one who observes it; and the habits of the insects are such as to utilise all these peculiarities, and render them available in such a manner as to remove all doubt of the purpose of this singular case of mimicry, which is undoubtedly a protection to the insect. Its strong and swift flight is sufficient to save it from its enemies when on the wing; but if it were equally conspicuous when at rest it could not long escape extinction, owing to the attacks of the insectivorous birds and reptiles that abound in the tropical forests. A very closely-allied species—Kallima machis—inhabits India, where it is very common, and specimens are sent in every collection from the Himalayas. On examining a number of these it will be seen that no two are alike, but all the variations correspond to those of dead leaves. Every tint of yellow, ash, brown, and red is found here, and in many specimens there occur patches and spots formed of small black dots, so closely resembling the way in which minute fungi grow on leaves that it is almost impossible at first not to believe that fungi have grown on the butterflies themselves! If such an extraordinary adaptation as this stood alone, it would be very difficult to offer any explanation of it; but although it is perhaps the most perfect case of protective imitation known, there are hundreds of similar resemblances in Nature, and from these it is possible to deduce a general theory of the manner in which they have been slowly brought about. The principle of variation and that of "natural selection," or survival of the fittest, and elaborated by Mr. Darwin in his celebrated "Origin of Species," offers the foundation for such a theory; and I have myself endeavoured to apply it to all the chief cases of imitation in an article published in the *Westminster Review* for 1867, entitled "Mimicry and other Protective Resemblances among Animals," to which any reader is referred who wishes to know more about this subject.

"During my very first walk into the forest at Batchian, I had seen sitting on a leaf out of reach an immense butterfly of a dark colour, marked with white and yellow spots. I could not capture it, as it flew away high up in the forest, but I at once saw that it was a female of a new species of Ornithoptera, or "bird-winged butterfly," the pride of the

Eastern tropics. I was very anxious to get it, and to find the male, which in this genus is always of extreme beauty. During the two succeeding months I only saw it once again, and shortly afterwards I saw the male flying high in the air at the mining village. I had begun to despair of ever getting a specimen, as it seemed so rare and wild, till one day, about the beginning of January, I found a beautiful shrub with large white leafy bracts and yellow flowers, a species of mussaenda, and saw one of these noble insects hovering over it; but it was too quick for me, and flew away. The next day I went again to the same shrub, and succeeded in catching a female, and the day after a fine male. I found it to be, as I had expected, a perfectly new and most magnificent species, and one of the most gorgeously-coloured butterflies in the world. Fine specimens of the male are more than seven inches across the wings, which are velvety-black and fiery orange, the latter colour replacing the green of the allied species. The beauty and brilliancy of this insect are indescribable, and none but a naturalist can understand the intense excitement I experienced when I at length captured it. On taking it out of my net and opening the glorious wings my heart began to beat violently, the blood rushed to my head, and I felt much more like fainting than I have done when in apprehension of immediate death. I had a headache the rest of the day, so great was the excitement produced by what will appear to most people a very inadequate cause. I had decided to return to Ternate in a week or two more, but this grand capture determined me to stay on till I obtained a good series of the new butterfly, which I have since named Ornithoptera crœsus. The mussaenda bush was an admirable place, which I could visit every day on my way to the forest; and as it was situated in a dense thicket of shrubs and creepers, I set my man Lahi to clear a space all round it, so that I could easily get at any insect that might visit it. Afterwards finding that it was often necessary to wait some time there, I had a little seat put up under a tree by the side of it, where I came every day to eat my lunch, and thus had half-an-hour's watching about noon, besides a chance as I passed it in the morning. In this way I obtained on an average one specimen a day for a long time, but more than half of these were females, and more than half the remainder worn or broken specimens, so that I should not have obtained many perfect males had I not found another station for them. As soon as I had seen them come to flowers, I sent my man Lahi with a net on purpose to search for them, as they had also been seen at some flowering trees on the beach, and I promised him half a day's wages extra for every good specimen he could catch. After a day or two he brought me two very fair specimens, and told me he had caught them in the bed of a large rocky stream that descends from the mountains to the sea, about a mile below the village. They flew down this river, settling occasionally on stones and rocks in the water, and he was obliged to wade up it or jump from rock to rock to get at them. I went with him one day, but found that the stream was far too rapid and the stones too slippery for me to do anything, so I left it entirely to him, and all the rest of the time we stayed at Batchian he used to be out all day, generally bringing me one, and on good days two or three specimens. I was thus able to bring away with me more than a hundred of both sexes, including perhaps twenty very fine males, though not more than five or six that were absolutely perfect."


TORTOISE-SHELL BUTTERFLY
(*Vanessa urticæ*).

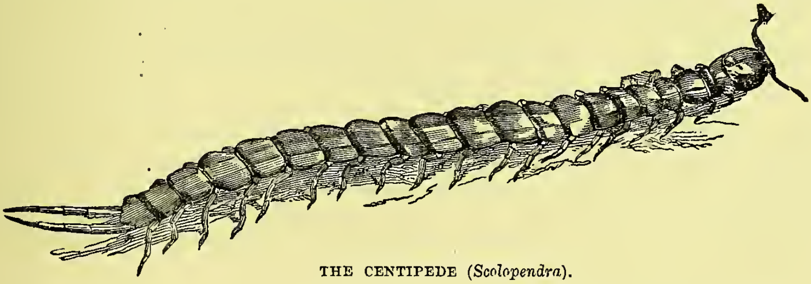

COMMON BUTTERFLY
(*Vanessa C. album*).

CLASS II.—MYRIAPODA.

In this class we have Arthropods with a distinct head, bearing one pair of antennæ. There is no well-marked separation between the body and the abdomen: both consist of a number of flattened segments, which bear the legs. The number of these segments varies from nine to more than one hundred and fifty, each of which will have either one or two pairs of jointed limbs, the last joint of which will form a claw. In by far the greater number the foot jaws are formed for masticating food, but a few have suctorial mouths. In their younger stages the body-rings are fewer in number, but there is no true metamorphosis as in insects. The number of simple eyes sometimes also increases with age; their respiration is tracheal, as in insects. There are the following orders in this class. In the first order, that called CHILOGNATHA, the body joints are more or less cylindrical. Each generally carries two pairs of feet: whence these animals are often called Millipedes. The antennæ consist of six or seven joints. We have here the familiar family of Glomeridæ, some of the species of which quite resemble the little wood-lice (*Onisci*); the Julidæ, of which we have several native species, all, however, of small size. Some tropical species attain a length of six or seven inches, the Siphonotidæ, the species of which are remarkable as having suctorial mouths.

THE MYRIAPOD (*Jules terrestris*).

In the second order, called CHILOPODA, the body joints are flattened, each with, for the most part, one pair of lateral feet, whence the name Centipedes, often applied to the species. The antennæ are generally slender, with many joints. They live on animal food—insects; and the bite of some of the large tropical species causes great pain in man, and sometimes a good deal of swelling and inflammation. There are but two families, that of the Cermatiidæ. One species (*Cermatia araneoides*) has fifteen pairs of very long feet. It is common in many parts of Southern Europe. Its long feet fall off on the slightest touch. It has got compound eyes. A second family, Scolopendridæ, contains the largest species in the class, and a great many species are known. Our native species have not at all been sufficiently investigated. One or two species are phosphorescent.



THE CENTIPEDE (*Scolopendra*).

A third order, PERIPATODA, we venture to make for the reception of a strange genus (*Peripatus*), which was first, when dissected by Guilding, placed among the Mollusca; since then, generally with the worms. But the remarkable discovery by Mr. Mosley, of the presence of tracheæ in the adult form induces us to place it here, just before the next family, in which tracheæ disappear. This fourth family, PAUROPIDA, contains but two species. Both those known are very minute, and have no tracheæ; one (*Pauropus huxleyi*) is British; another (*P. lubockii*) is American.

CLASS III.—ARACHNIDA.

The members of this class are air-breathing Arthropods, with respiration effected either by tracheæ or in a special lung-like cavity. They have no antennæ, though Latreille considered their upper jaws to be modified antennæ. They are mostly terrestrial, with mouths formed either for suction or mastication; the head is fused into one mass with the body (cephalo-thorax), and has four pairs of limbs. In some the integument is hard, as in the scorpion, but in most it is soft and extensible, as in spiders and mites. The salivary secretion (or at least a glandular secretion) in some spiders has, as is well known, a poisonous effect on flies; the poison-gland in the scorpion is in its tail. While the respiration in many is tracheal, and in some (spiders) by pulmonary sacs, in others, as in many mites, no respiratory organ beyond the common integument is known. With the exception of some Tardigrades, the sexes are not united in the same individual. Most of them feed on other animals, either swallowing them alive or sucking their blood; but some feed on decaying substances.

Their eyes are simple and vary in number; their palpi seem to act as organs of feeling, though doubtless the long feet of spiders also serve as such. Most of them lay eggs; though some, as the scorpion, are viviparous. After their escape from the egg they undergo no true metamorphosis, though they cast their skin more than once; and, in the mites, have only at first three pairs of legs. There is also an obscure, ill-marked change of form in some of the very curious marine spiders (*Pycnogonum*). Though the power of reproducing lost parts is small, yet some spiders and harvest-men possess it. The remarkable silk-spinning glands of some of the spiders will be described further on. We may divide the class into the following two sub-classes:—

I.—THE PSEUDO-ARACHNIDA.

This sub-class contains some very curious, lowly organised forms. They belong to two very different orders. The first order, PYCNOGONIDA, contains the marine spiders. These are very slowly moving animals, living on marine plants or under stones covered by every tide; some few live on fish. They undergo a species of metamorphosis, and have no distinct organs of respiration. The second order, TARDIGRADA, are mostly microscopical animals, living in damp moss or in little pools of rain water. Their size is so inconsiderable (from $\frac{1}{20}$ to $\frac{1}{50}$ of an inch in length) that they are scarcely visible to the unassisted vision. They have oblong, symmetrical, non-ciliated, and very contractile bodies, admitting of their rolling themselves into a ball, and of otherwise varying their figure. The head is somewhat produced, assuming a conical or pyramidal figure. The mouth opens posteriorly in a pharyngeal muscular bulb, with a horny articulated dental apparatus, serving to crush food, but less highly organised than in Rotifera. Under the polarising microscope the manducatory organs exhibit the same appearance as horn. From them the food passes into an elongated tubular stomach, or intestine, continued straight through the body, and terminating in an anus at the posterior extremity. In its course it presents numerous lateral offshoots or diverticula.

No form of respiratory or circulatory apparatus has been detected; but a multitude of granules and corpuscles are seen to float freely in the general cavity between the integument and the alimentary canal, which Doyère supposed to be concerned in the processes of nutrition, and to be analogous to blood-corpuscles. M. Quatrefages states that the fluid within the body is in perpetual irregular motion. The nervous system is well developed. It consists of a chain of ganglia, with intercommunicating (anastomosing) nerve-fibres, besides a central or cerebral ganglion. The eyes are variable and fugacious. The sense of touch may be presumed to reside specially about the suctorial mouth and its contiguous palpi. All the Tardigrada are hermaphrodite. The ovary is of large size; but the ova, according to Kölliker and Frey, do not in the course of development exhibit a germinal disc. In this they differ from other Arthropoda. Few eggs are produced at a time, and are of large size. They are, curiously enough, found in the exuviæ, or moultings of the animals, for from time to time the outer skin is cast off. M. Doyère convinced himself of the existence of a testis and spermatozoa. Dujardin says the embryo emerges from the ovum perfect in form; but Kauffmann, on the contrary, affirms that they undergo some degree of metamorphosis ere they attain the adult structure.

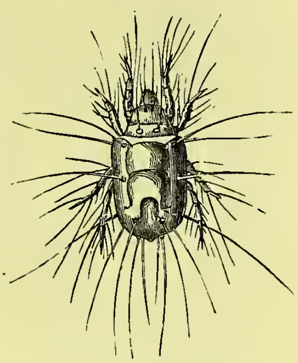
The Tardigrada have received their name from their slow movements. They are parasitic animals, and live by sucking the juices from other beings. They are common upon water-plants and vegetable *débris* in ponds; yet immersion in water is not necessary, since they are found, like Rotifers, in the dust and rubbish on the roofs of houses (a locality in which they were first encountered by Spallanzani), and especially amid the small lichens, mosses, &c., which spring up in such situations. Mosses are favourite hiding-places for these creatures. On shaking portions of mosses or semi-aquatic plants in a basin of water, the Tardigrada will fall to the bottom, and may be easily collected.

In most vital phenomena they very closely accord with Rotatoria; thus, like these, they can be revived after being put into hot water at 113° to 118° Fahr., but are destroyed by immersion in boiling water. It is also by their capability of resuscitation after being dried that they are able to sustain their vitality in such localities as the roofs of houses, where at one time they are subjected to great heat and excessive drought, and at another are immersed in water.

II.—THE AUTARACHNIDA.

This sub-class contains the Mites, Spiders, and Scorpions. In all there is a more or less well-developed abdomen. There are three orders.

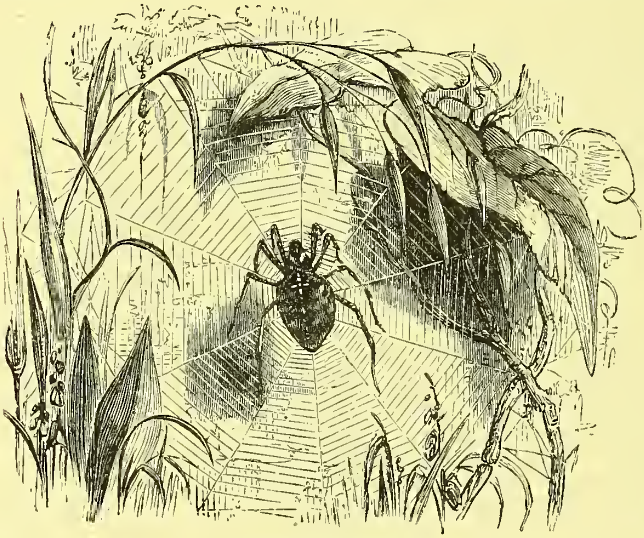
In the first order, Acarina, we have the Mites. These are soft-skinned; the head, body, and abdomen are joined nearly into one. This order contains nine or ten families and an immense number of species, many of them very well known as living on almost all forms of animal life, from man down to water-beetles. Some of these (*Pentastoma*) are quite worm-like parasites, living in the nostrils of the dog or in the liver of man and other animals. Among the true mites, one (*Demodex folliculorum*) lives as a parasite in the sebaceous follicles of the human face. It has a worm-like body. Another (*Sarcoptes scabiei*) digs into the human skin, and is the disagreeable cause of itch. Other species occur on domestic animals. Some live in cheese (*Acarus domesticus*), and are even eaten by man. Of the Ticks, some live on bushes and ferns; though when one (*Ixodes ricinus*) gets a chance it attaches itself to man or any other animal, and, sucking their blood, will soon swell to the size of a big pea. One or two species are said in America to be dangerous to man and cattle.



THE CHEESE MITE (*Acarus domesticus*).

The Spider Mites are small eyeless creatures, parasitical on bats, birds, reptiles, and insects. A species (*Argas persicus*) is said sometimes to fasten on man, when its bite causes in the young convulsions, delirium, and in some cases death. One of this group (*Gamasus coleoptratorum*) attaches itself to beetles; and sometimes the body of the common dung-beetle, that flies so heavily in the dusk, will be found covered over with dozens of these mites. The Water Mites form a large family by themselves. They live on water plants when young, though they are not parasitical when adult. Perhaps every one has seen in some clear mill-pond one of the prettiest, a soft vermilion-coloured mite (*Limnochares holoserica*). The little red mites so often seen over fruit (*Trombidium holosericum*), with a felty look, slightly quadrangular, are parasitic on the Aphides, and ought to be regarded as the gardener's friend; but another nearly-related form (*Tetranchus tiliarum*) will weave a fine close web over the leaves of the lime and other trees, and in this way will do them some injury.

In the second order, Araneina, the abdomen is joined to the head and body portion by a short though distinct stalk. The respiration is in most pulmonary, though in some tracheal. All of them form a silky, filamentous substance, with which they cover their eggs. Many from the same substance form webs and nets, in or with which they capture their prey. At the end of the abdomen will be found four, or in most species six, of the spinning glands (spinnarets), which are covered with fine tubules, through which the silky matter escapes. The long gossamer threads that cover the fields or float in the air in the autumn months (*fils de la Vierge* of the French) are now known to be produced by spiders. The spiders are all insect feeders. They undergo no metamorphosis or change of form, though they moult their skins very frequently. Under the guidance of their respective instincts, a high degree of skill and industry is displayed by spiders in the construction of their retreats. Many species occupy holes formed by themselves beneath the surface of the earth, some of which, of a cylindrical shape, are lined with a compact tissue of silk, and have the entrance closed by a valve provided with a hinge, which can be opened and shut at pleasure. Other species fabricate in the crevices of walls, the crannies of rocks, beneath stones, on the leaves of vegetables, and under the ex-foliating bark of trees, tubes, cells, or domes of silk, on the exterior surface of which soil minute pebbles and other heterogeneous materials are frequently distributed. Theridion riparium fabricates a slender conical tube of silk of a very slight texture, measuring from an inch and a half to two inches and a half in length, and about half an inch in diameter at its lower extremity. It is closed above, open below, thickly covered externally with bits of indurated earth, small stones, and withered leaves and flowers, which are incorporated with it, and is suspended perpendicularly by lines attached to its sides and apex, in the irregular snare constructed by this species. In the upper part of this singular domicile the female spins several globular cocoons of yellowish-white silk of a slight texture, whose mean diameter is about one-eighth of an inch, in each of which she deposits from twenty to sixty small spherical eggs, of a pale yellowish-white colour, not agglutinated together. The young remain with the mother for a long period after quitting the cocoons, and are provided by her with food, which consists chiefly of ants.



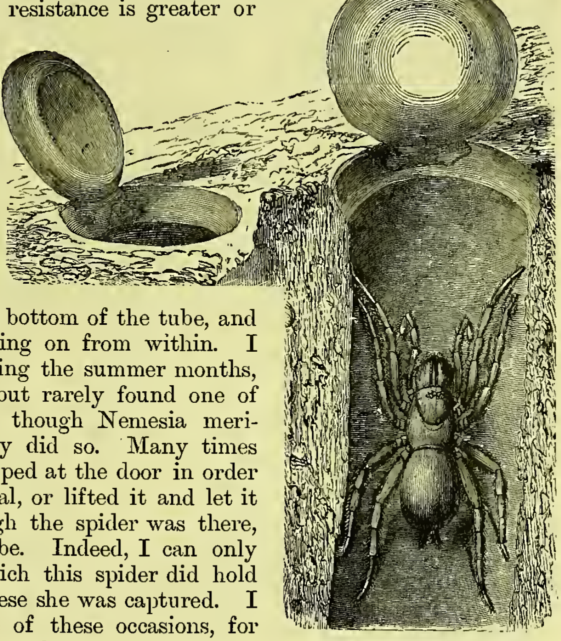
EPEIRA DIADEMA.

Various spiders run fearlessly on the surface of water, and some even descend into it spontaneously, the time during which they can respire, when immersed, depending upon the quantity of air confined by the circumambient liquid among the hairs with which they are clothed. In this manner Argyroneta aquatica is enabled to pursue its prey, to construct its dome-shaped dwelling, and to live habitually in that liquid. There are, however, a few species of small size, Neriëne longipalpis and Savignia frontata, for example, which, though they do not enter water voluntarily, can support life in it for many days, and that without the external supply of air so essential to the existence of Argyroneta aquatica under similar circumstances. It is probable that this property may contribute to their preservation through the winter, when their hibernacula are liable to be inundated.

This order is generally divided into two sub-orders. Sub-order 1.—TETRAPNEUMONES. In this sub-order are many large and curious spiders. They possess but four lung cavities, and four spinnarts, and have eight little eyes packed near together. One of the species (*Mygale avicularia*), a large spider of South America, has the body 1″ 6‴ and more, the hind legs 2″ 3‴. It lives in a tubular web narrowed behind, in chinks of bark of trees, between stones, &c. The female places the web in which she has laid her eggs close to her nest. It has been asserted that these spiders are able to seize small birds (humming-birds), and hence the name of this species. There is, however, no reason to think that the account is well founded, or anything better than fable.

Another species (*Cteniza fodiens*), of Southern Europe, which certain exotic species resemble, lives in vertical tubular cavities underground, closed by a circular cover as by a door, and lined internally with silken web. On the inside of the cover are small impressions, to which the spider attaches itself by means of the hooklet of the jaws, holding fast to the walls of the tube with its feet, in order to keep the door close when an attempt is made to open it. It shuts down by its own weight.

Another species found in the same district (*Nemesia cæmentaria*) also builds such a nest. It is thus described by Mr. Moggridge:—"The cork nests are the simplest form of nest, with the exception of those described above from Jamaica, and have constituted, up to the present time, the only type known in Europe. Their chief claims to our admiration lie in the perfection of workmanship which the doors usually exhibit, and the marvellous concealment which they afford when closed. These doors, as a rule, fit so tightly (thanks to the accurate adjustment of their sloping sides to the bevelled lip of the tube which receives them) that they afford a certain amount of mechanical resistance, even when the spider is away. But, after examining a very large series of these cork nests, I find that there is some variation in the degree of perfection attained in their work by different individuals of the same kind. The mechanical resistance is greater or less, in proportion to the thickness and weight of the door, and to the slope of its sides, and of the bevelled edges of the tube; and in each of these details a marked difference may be observed. One might suppose, from what has so often been repeated as to the habits of N. cæmentaria, that whenever any one attempts to open the door the spider, which is always at home in the daytime, would dart up from the bottom of the tube, and endeavour to keep it closed by holding on from within. I cannot say what may take place during the summer months, but from October to May I have but rarely found one of these spiders ready to oppose me, though Nemesia meridionalis and N. Eleanora frequently did so. Many times wishing to provoke them, I have tapped at the door in order to apprise the occupant of my arrival, or lifted it and let it fall again, and always in vain, though the spider was there, crouching at the bottom of her tube. Indeed, I can only recall six or eight instances in which this spider did hold down her door, and on three of these she was captured. I will now relate what I saw on one of these occasions, for there has been much speculation as to the manner in which the spider clings to the door, and offers the determined resistance which is experienced. No sooner had I gently touched the door with the point of a pen-knife, than it was drawn slowly downwards, with a movement which reminded me of the tightening of a limpet on a sea-rock, so that the crown, which at first projected a little way above, finally lay a little below the surface of the soil. I then contrived to raise the door very gradually, despite the strenuous efforts of the occupant, till at length I was just able to see into the nest, and so distinguish the spider holding on to the door with all her might, lying back downwards, with her fangs and all her claws driven into the silk lining of the under surface of the door. The body of the spider was placed across, and filled up the tube, the head being away from the hinge, and she obtained an additional purchase in this way by blocking up the entrance. I did not force the spider to release her hold, but by a rapid stroke with a long-bladed knife cut out the upper part of the tube with the surrounding mass of soil, and thus secured the trap-door and its owner."



THE TRAP-DOOR SPIDER (*Cteniza fodiens*).

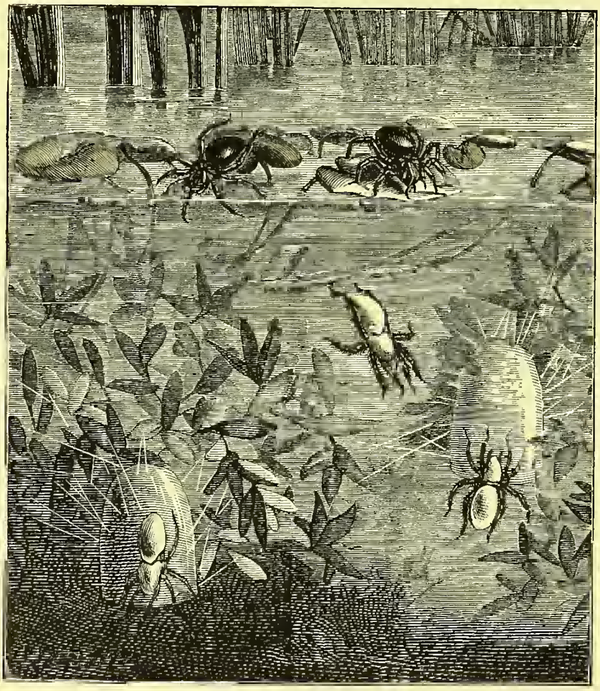
In the second sub-order, DIPNEUMONES, the lungs are but two. The spinnarets, six in number, and the little eyes, are scattered over the cephalo-thorax. We find here the Diving Spider (*Argyroneta aquatica*), 6‴ long, one of our largest native species; thorax red-brown, abdomen blackish, the first pair of legs longer than the rest. This spider lives in fresh water. As it swims the abdomen and the thorax have a silvery aspect from the attached stratum of air. This species spins a ball-shaped waterproof web, that is filled with air and open below; this it attaches to water plants by threads.

The well-known Domestic Spider (*Aranea domestica*) weaves close, adhesive, nearly horizontal webs in the corners of walls, in chamber windows, &c., and a tube close by the net is a lurking-place, in which they wait for their prey.

That dangerous species (*Latrodectus malmignatus*), found in Italy and Corsica, and named Malmignato, has thirteen carmine-red spots on the abdomen. Its bite is poisonous, and is said to cause strong convulsions.

The Running Spiders do not construct nets or webs, but capture their prey by running (*Lycosa*). These live on the ground, and the females carry their egg-sacs about with them.

The Leaping Spiders, in addition to running, have a power of leaping, and some of the species are wonderfully like ants (*Myrmecium rufum*).



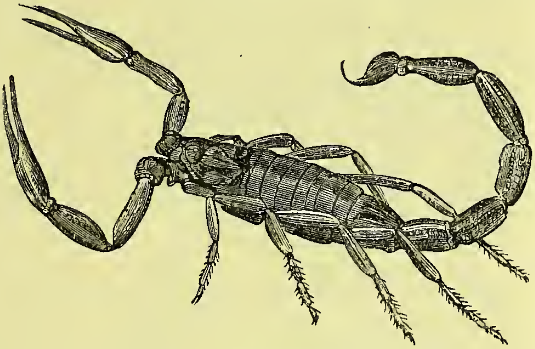
THE WATER SPIDER (*Argyroneta aquatica*).

The members of the third order (ARTHROGASTRA) differ from the mites and spiders in having the abdomen in segments, and the palps of their mandibles (jaws) developed into pincers or chelæ. It may be conveniently divided into the following sub-orders:—

In the first (PHALANGITA) are found the harvest-men, to be met with in our grass fields. These little animals have very long, slender feet; they run very rapidly, and are to be found lurking in the chinks of walls or on the ground between stones. The thin legs come off very easily, and after their separation from the body present for a little time indications of remaining irritability. In the second (PSEUDOSCORPIONES) are some little creatures with the appearance of being little scorpions, only they want tails. One species (*Chelifer cancroides*) at least is not uncommon in our houses, especially among old books. Its body is scarcely one-twelfth of an inch long, but its claws are nearly twice as long as its body. It is of a brownish-red, likes to live in dark places, feeds on mites and small wood-lice, and for so small a creature can make itself look very formidable.

A writer in the *Entomological Magazine* thus describes their manner of capturing their prey:—"Last summer I watched the manœuvres of a common house fly that had one of these crab-like dependents attached to its leg. It was in the window of a cold and damp out-office. The fly appeared but little annoyed, and continued to travel tardily about the glass, while its hanger-on busily occupied its free claw in seizing such minute objects as came in its way—at least such appeared to be its business. On attempting to catch the fly, off it flew to another window with its wingless passenger. I followed closely and quickly, when lo! the little appendix relaxed its grasp, and dropped itself into a crevice in the frame, where I secured it. Intending to experiment, I put it into a pill-box with a fly, to the leg of which it soon clung, and would, with its neighbour's help, have speedily escaped, had it not been prevented by my shutting them up together till another opportunity. But next morning my curiosity was dead. On recollecting these facts, the following queries occur to my mind:—Does not the chelifer experience inconvenience, in consequence of its construction, when it would be pursuing its prey ? and does is not take advantage of the leg which the fly so readily offers that it may ride out on its hunting excursions, and, by the aid of the fly's legs and wings, get cheaply conveyed from place to place ? Is not one of its claws especially adapted for this purpose ? and are not the resorts of the fly those which furnish prey for its occasional companion ? If so, do not these circumstances present an additional instance of accommodating provision, which is so often most beautifully illustrated in the habits of insects ?

"The Chelifer cancroides is very abundant throughout the year on planks and bricks that are placed on decayed vegetable matter, where it preys on minute Diptera. Lonchæa vaginalis, a fly common in the same situations during the month of June, is particularly infested by it, and also by Acari, and may be often seen on windows with from one to four of these chelifers attached by their claws to its legs, and apparently without sustaining any injury from them. The other day we put several of both into a bottle, and often, when the fly approached the chelifer, the latter immediately extended one of its claws, and seized the fly by the end of the tarsus; with the other claw it grasped either the middle of the tarsus or the costal nervure of the wing, and then loosened the hold of each of its claws alternately, till it arrived at the trochanter, where it remained fixed. We added three other flies, belonging to the genera Anthomyia, Sepsis, and Borborus. The first, a much more active insect than the Lonchæa, was soon seized by a chelifer. It used its utmost efforts to disengage its tarsus without success; however, the chelifer soon released its hold of its own accord. When we looked at the insects the following day the Lonchæa, the Anthomyia, and the Borborus were alive, and only the first had a chelifer attached to it; so, likewise, had the Sepsis, whose death was probably occasioned by confinement, not by any wound."


A SCORPION.

In the third sub-order (SCORPIONIDA) are found the well-known Scorpions. They have not only large claws, but also most formidable stinging weapons; the six last segments of their abdomen somewhat abruptly contract, so as to resemble a tail, and the last segment terminates in an incurved sting, at the base of which sting is the poison gland. Behind the last pair of legs will be found a pair of comb-shaped appendages, and the number of the teeth in these combs seems to vary in the different species. The scorpions are only to be found in the warmer regions, the temperate zone, and in tropical countries. They live chiefly on insects, though some of the larger species will capture small lizards. However painful, there would seem no well-authenticated record of any human being having died from the effects of a scorpion's sting. The female scorpion is most assiduous in her care of her young, carrying them on her back when just hatched, and looking after them when they are unable to look after themselves. They are chiefly ground-dwelling insects, feeding at night, and to be looked for during the day under stones or leaves.

In the fourth sub-order (PEDIPALPI) are a few spider-like forms; but they have long chelæ or claws, and are chiefly to be found in the hottest parts of Asia and America. The fifth sub-order (GALEODEA) contains but a single genus (*Galeodes*), though there are several species, which are chiefly found in Africa. One (*Galeodes araneoides*) is from Greece and Southern Russia. It resides in warm sandy regions, coming out at night. Its bite is said to be very venomous and dangerous, but this wants verification.

CLASS IV.—CRUSTACEA

This is the last class of articulate animals with jointed feet, and unlike the animals in the former classes, these breathe by means of gills, which are very delicate prolongations of portions of the body of the animal, into which the blood is carried, and in which, being exposed to water containing oxygen, the blood is oxygenated. They have mostly the form either of filaments or flat sacs. The normal number of gills is five pairs, but in some only three pairs are to be found. In others the gills can scarcely be said to exist, and in some forms the skin itself seems to serve for respiration. They differ also from other Arthropods in having feet developed from the abdominal segments as well as from the true body segments. In this they may be said to resemble the Myriapods, but the difference in respiration will serve as a distinction between these.

The name of the class is derived from the nature of their external covering, which is often hard, and contains more or less of carbonate of lime. In other cases, however, the integument is horny, or even soft. The shell, when one is present, consists of different layers, and some of them are often brilliantly coloured. Between the segments or rings the integument is thin and flexible.

The head is generally joined very intimately with the body, forming a cephalo-thorax. The eyes and antennæ, or feelers, will indicate the true head portions. The eyes are almost always compound, and are often fixed on eye-stalks, which are movable. The mouth is situated on the anterior and lower portion of the body. The jaws are arranged in pairs and move sideways. In some Crustacea these are modified so as to form a suctorial mouth. The shield-like shell, which is so well developed in the common crab, is called the carapace; and in those with ten feet the gills are to be found in a cavity at either side of the body, under this carapace. The intestinal canal is short and straight. In some there is a well-marked stomach, often provided with horny or shelly plates, and with thick muscular walls.

The circulation of the blood is very perfect. The heart is arterial and on the dorsal surface of the body. The blood is either reddish or pale violet, or colourless. The nervous system consists of a long chain of ganglia along the ventral surface of the body, with some well-marked nervous ganglia just before and behind the gullet.

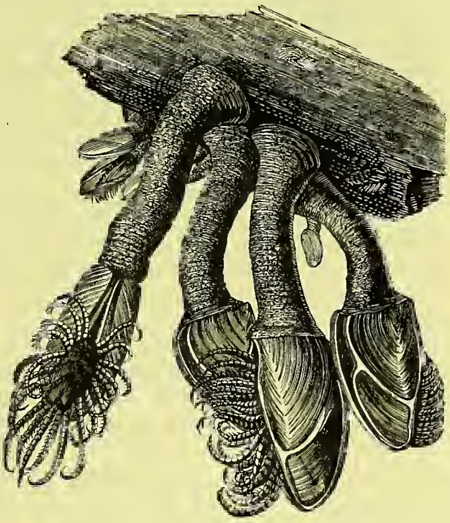
In nearly all, the sexes are distinct, and often different in size and markings. The eggs, after they are laid, often continue attached to different parts of the parent's body, and there they are hatched. In some they are lodged in special brood cavities, but in others they are attached to stones or aquatic plants.

In very many there is a most wonderful metamorphosis, or change of form, in which, after leaving the egg, the young crustacean passes through several most different forms. It is to be noted that when it arrives at its adult form it by no means arrives at its adult condition, but only reaches this after a prolonged series of moults. In this respect this change of form differs from that noticed in the true insects, where the adult stage and condition were arrived at simultaneously. Tracing this metamorphosis in the common Shore Crab, from the egg proceeds a free swimming larval form, wonderfully grotesque-looking, not half a line long, with an ovoid body, a large and inflated back, ending in a long spine; nearly transparent, and with two large stalkless eyes; at the lower margin of the body are the swimming feet, behind them five equal-sized joints form a tail. These little creatures are wonderfully active, swimming about by means of their tails. By-and-by this activity ceases; they retire to the sandy bottom, cast their coats, and get a new form. In their first stage they are called Zoea; in the second Megalope. These latter differ much from the first form, and are more nearly related to the form of the adult animal. The eyes are now on stalks; the first pair of claws have nipper-like endings; the tail is relatively greatly diminished, sometimes even partially bent under the body. After another moult the adult form in miniature is reached, and then it is only a matter of growth when the full size is attained. Sometimes these changes are undergone before the young animal is hatched. With the ordinary moulting of the external integument there is also a shedding of the calcareous portions of the stomach. The power of reproduction of lost parts is very great in this class, so much so that even a whole leg, if broken off, is replaced by a new one.

The vast majority of the Crustacea are found in salt water; some are inhabitants of fresh water, and some few are terrestrial. More than three thousand species are known. Our space will not allow us to enumerate even all the orders, but the following sub-classes must be mentioned :—

SUB-CLASS I.—CIRRIPEDIA.

These are marine Crustacea, which, when they arrive at their adult form, are found affixed to rocks or floating timber, &c., being included in a shell of many valves or parts. The now well-known history of their development leaves no doubt as to their affinities. Commencing their life as free swimming forms, they soon become attached. Some are pedunculated, others are sessile. Their filamentous limbs during life are being constantly extended, from the opening of their shells, and as constantly drawn in again, having in the act introduced into the shell the water for respiration, and with it particles of food. Unable, for want of space, to refer to the orders of this sub-class, we must not, however, omit mention of the Sea Acorn Shells, which are found all over our rocky coasts, from the region of high to nearly low water mark. Perhaps the commonest species is Balanus sulcatus. Another common species, the Barnicle (*Lepas anatifera*), is a stalked form, often thrown on our coasts adhering to logs of timber. Even still, in different districts of the North of Scotland, some few believe that a species of goose has its origin from this crustacean: hence it is called Barnicle Goose (*vide* Birds, p. 332).


THE BARNICLE (*Lepas anatifera*).

Mr. Charles Darwin, who has written a monograph of this sub-class, tells us that "the Pedunculated Cirripedes extend over the whole world; and most of the individual species have large ranges, more especially, as might have been expected, those attached to floating objects. Excepting these latter, the greater number inhabit the warmer, temperate, and tropical seas. Of those attached to fixed objects, or to littoral animals, it is rare to find more than three or four species in the same locality. On the shores of Europe, I know of only three, viz., a Scalpellum, Pollicipes, and Alepas. At Madeira, (owing to the admirable researches of the Rev. R. T. Lowe), two Pœcilasmas, a Dichelaspis, and an Oxynaspis are known. In New Zealand there are two Pollicipes and an Alepas, and, perhaps, a fourth form. From the Philippine Archipelago, in the great collection made by Mr. Cuming, there are a Pœcilasma, an Ibla, a Scalpellum, Pollicipes, and Lithotrya. Of all the Lepadidæ, nearly half are attached to floating objects, or to animals which are able to change their positions; the other half are generally attached to fixed organic or inorganic bodies, and more frequently to the former than to the latter. Most of the species of Scalpellum are inhabitants of deep water; on the other hand, most of Pollicipes, of Ibla, and Lithotrya are littoral forms. The species of Lithotrya have the power of excavating burrows in calcareous rocks, shells, and corals. Anelasma has its sub-globular peduncle deeply embedded in the flesh of Northern sharks; and I have seen instances of the basal end of the peduncle of Conchoderma aurita being sunk into the skin of Cetacea; in the same way the point of the peduncle in the male of Ibla is generally deeply embedded in the sack of the female. I believe in all these cases, the cementing substance affects and injures the corium or true skin of the animal on which the creature is parasitic, whilst the surrounding parts, being not injured, continued to grow upwards, thus causing the partial embedment of the Cirripede. In the case of Anelasma, we have growth at the end of the peduncle, and consequently downward pressure, and this may possibly cause absorption to take place in the skin of the shark at the spot pressed on."

SUB-CLASS II.—COPEPODA.

This sub-class includes a number of interesting forms. Some are free swimming, minute, fresh or salt-water forms, such as *Cyclops signatus*, which is to be met everywhere in water, even in puddles, gutters, and cisterns of rain water. Without doubt, every one has, some time or another, swallowed this minute crustacean. It can bear to be frozen up, and yet can be restored to activity. Some of the marine forms (Sapphirina) are lovely creatures. Again, very many of the sub-class are in the habit of living on fish or other crustacea. These have suctorial mouths, and soft, most strangely-shaped bodies; they are commonly known as Lerneans. Some are attached by means of the head itself, which is furnished with one or more pairs of horn-shaped appendages projecting laterally; others by means of long arm-shaped appendages springing from the thorax, united to each other at the tip, and terminating in a horny button in the centre; a third set, again, are fixed by the aid of stout foot-jaws, armed with strong hooks.

SUB-CLASS III.—OSTRACODA.

In these minute forms the body is compressed, and included in a bivalve shell, with a dorsal hinge, so that the whole animal might easily be taken for a little two-valved shell. They have swimming feet, and either one or two eyes. There are both marine and fresh-water species. One of the commonest species is, perhaps, Cypris monacha. Baker is said to be the first author who has taken any notice of any of the animals of this family. In his work, "Employment for the Microscope," 1753, an anonymous correspondent describes at some length an insect which has a bivalve shell, somewhat resembling a small fresh-water mussel, and gives a figure of it lying on its back, which is barely sufficient to enable us to discern that it is a Cypris.

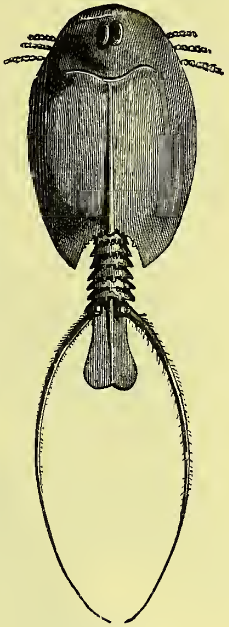
Up to the time that Müller undertook the working out the species of this genus, our knowledge of them was indeed scanty. The descriptions found in authors previous to him were so superficial, that even when illustrated by figures, which were also generally very bad, there was no possibility of distinguishing what species they meant to describe.

The food of these little creatures consists of dead animal matter, confervæ, &c. Straus says he never saw them attack living animals when they were well and strong, but he has frequently seen them attack worms, &c., when wounded and weak. Though dead animal matter was their choice, they will not, he adds, eat it when putrid. They no doubt also prey on each other, as I have often observed individuals of one species devouring eagerly the dead carcases of species different from themselves. When the ponds and ditches in which they live dry up in summer they bury themselves in the mud, and thus preserve their lives as long as the mud retains any moisture, becoming as active as ever when the rain falls and again overflows their habitations. After long-continued drought, however, when the mud becomes very dry and hard, they perish; but the eggs do not perish along with the parents, for they can be hatched in four or five days after being placed in water.

These little creatures seem to be very lively in their native element, being almost constantly in motion, either swimming about rapidly by the action of their antennæ, or walking upon the plants and other solid bodies floating in the water. Instead of being fixed to one place, and condemned to live amidst eternal darkness, like the molluscous animals to which they bear such resemblance in external covering, "they," to use the words of Müller, "by opening their valves enjoy light, and move at their will, sometimes burying themselves in the mud, sometimes darting through the water, the humid air of their sphere. If they meet any unforeseen object, they conceal themselves all at once in their shells and shut the valves, so that force and address seek in vain to open them."

SUB-CLASS IV.—BRANCHIOPODA.

In this sub-class the feet serve also as organs to bear the gills. Most of the species are fresh-water forms and of small size. The body has no shell. One species (*Branchipus stagnalis*) is so like an insect larva that Linnæus himself mistook it for one. It lives in still fresh-water, or even in pools along a road. Another species (*Artemis salina*) lives in salt marshes, and is called Brineworm. Another rather larger form (*Apus cancriformis*) has rather a large shell, which covers it over as with a shield. The number of articulations, or separate pieces, of which the body of these animals is composed, is extraordinary. Schæffer, with wonderful patience, undertook the task of counting them, and in a table, in which he enumerates them *seriatim*, reckons the number to be 1,802,604! and Latreille says that we may safely take them to be not less than two millions!


APUS PRODUCTUS.

Apus cancriformis inhabits stagnant waters, though they are by no means so commonly to be met with as many of the other kinds of Entomostraca. They appear to be more local, and sometimes disappear from their usual haunts, reappearing some years afterwards in the very same place. "In warm, calm weather," says Schæffer, "they assemble upon the edges of the ponds, and nearly on the surface of the water, but in stormy or cold weather they are no longer to be seen." They can swim as freely upon their back as upon their inferior surface, and in both these positions we may see their feet continually in motion, alternately from below upwards, and from right to left, fatiguing the eye to follow them. Indeed, their branchial feet seem never at rest, for when the animal no longer uses its rami, but floats idly on the water, these organs are still in rapid motion, causing a sort of whirlpool in the water, and attracting towards their mouth the objects floating about them. Their chief food appears to be the smaller species of Entomostraca, which generally are found in great abundance in the same places, such as Daphniæ and Cyprides, the shells of which latter little creatures they can easily break down by means of their strong mandibles. Schæffer says they perish very quickly after being taken out of the water, or when the ponds dry up. It appears, notwithstanding, that after a pond has been dried up for some time, and suddenly filled anew by heavy rain, in two days these animals will be seen in abundance. The eggs certainly retain their vitality long after being dried, for these little creatures have been known to appear in a ditch that was suddenly filled with water after having been dried up for two or three years. Frogs seem to be their chief enemy, and they are generally to be met with in a more or less mutilated state.

To this sub-class the Trilobites, extinct crustacea, are supposed to be allied.

SUB-CLASS V.—POECILOPODA.

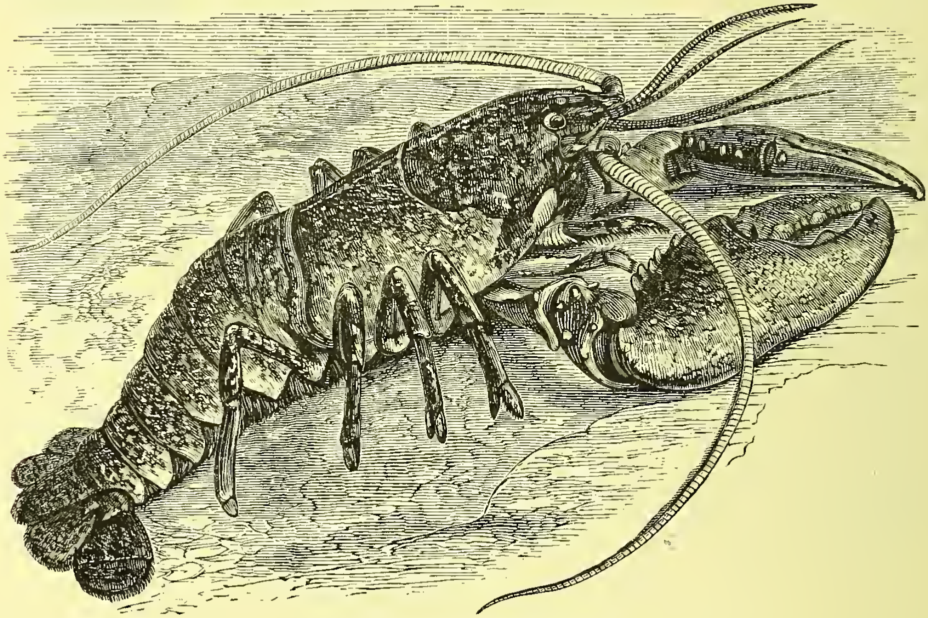
This sub-class now contains only the one genus of King Crabs. The best known of these (*Limulus gigas*) is found on the shores of the islands of Sunda and Molucca; its Malay name is *Mimie*. The Limuli live constantly in pairs, and are also sold in pairs. In the months of July and August they are daily taken in quantities near the roads of Batavia, and brought alive to market. The Malays eat the eggs with avidity, and the flesh also is agreeable to them and to the Chinese. These animals can live more than a day out of water. When laid on the back, they are able to right themselves by means of their tail, which is also a powerful instrument of defence.

SUB-CLASS VI.—DECAPODA.

The species of this sub-class will be easily recognised from their eyes being on movable stalks. They respire by special gills. They have five pairs of locomotive limbs (decapods), and embrace such well-known forms as crabs and lobsters. Of the three orders, the first, **Macroura**, has the abdomen long, as in the lobster, and fitted for swimming. Here are to be placed the Spring Lobsters (Palinuridæ), the Cray-fish (Astacidæ).

The Lobster (*Homarus vulgaris*) is universally held as a delicate article of food, and the multitudes which are annually taken and brought to our markets render it, perhaps, the most interesting and important of the whole class in a commercial point of view. Lobsters are taken on various parts of our coast, particularly on rocky shores. From the southern and western coasts of England a considerable number are constantly sent off to the London markets by the South-Western Railway from Southampton, and by the Great Western from Bristol; also by steamers from Guernsey and Jersey; and again from the coasts of Ireland to Liverpool. From the coast of Scotland and the Orkney and Lewes Islands it is computed that not less than 150,000 reach the London market yearly; but the principal supply is from Norway, from whence are derived not less than 600,000. There is often, in the season, a supply to London of not less than from 20,000 to 25,000 lobsters in one day. If we allow only as many to be eaten in the whole of England besides as in London, the multitude which are consumed in the course of every year is enormous.

The period in which this immense sacrifice to crustacean gastronomy principally takes place is from March to August; but it is a mistake to suppose that the lobster is only in season during that time. During the latter part of August and the following month the lobsters are shedding their coats, and the new covering is becoming indurated; but after that time they feed ravenously, and soon become plump and firm, so that in the winter they are probably in as high flavour and as solid for food as during the period when they are most in request. Mr. Saunders supposes the lobster to be very stationary, seldom wandering fifty miles from the spot of its birth; and he adds, what one could scarcely have supposed probable, that "they are as varied in appearance and character as a white man and an African." "I could tell by looking at them," says Mr. Saunders, "the part from whence they are brought." This curious fact is corroborated by Mr. Couch, who, in his "Cornish Fauna," has the following observation:—"Lobsters do not stray far from their haunts, and hence the discovery of a new station is a fortunate circumstance for the fisherman; and each situation is found to impress its own shade of colour upon the shell."



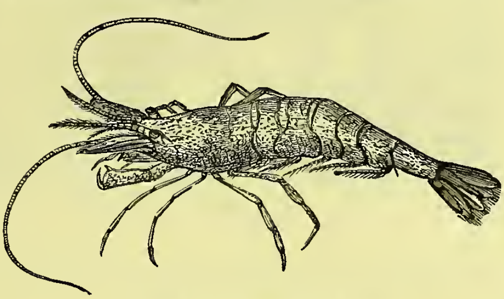
THE LOBSTER (*Homarus vulgaris*).

Lobsters are frequently caught in pots, similar to those which are employed for the capture of crabs, and by somewhat similar means; but in some localities the pots are differently shaped, being formed of nets, which are held in a cylindrical form by three hoops, one at each end and one in the middle. At one end the trap is closed, at the other it is entered by a funnel-shaped prolongation of the net, like some rat-traps.

The Shrimps (*Crangonidæ*) belong to the same order. To this family our Common Shrimp (*Palæmon vulgaris*) belongs. The carapace in this species is large, rounded, somewhat depressed, particularly towards its anterior part. There is no rostrum, but a slight elevation on the median line, between the eyes; a minute spine directed forwards over the gastric region, and one a little more conspicuous on each branchia. The eyes are conspicuous, naked, and not very distant. The external antennæ have the peduncle about half the length of the movable plate, which terminates in a small spine; its internal margin dilated and hairy. The internal antennæ are placed very little above the external, and terminate in two short filaments. The external pedipalps are of considerable length, extending forward beyond the peduncles of the external antennæ, the terminal joint much elongated.

The anterior legs are robust and smooth, the hands furnished with a curved movable finger, which is inflected to meet a small spiniform rudimentary thumb. The remaining legs filiform, elongated; the second the most slender and minutely didactyle; the others monodactyle. A strong spine on the sternum between the anterior pair of legs. Abdomen regularly tapering, rounded, and smooth. The tail with the middle lamina narrow, and pointed at the extremity. Abdominal false feet very long. Colour greyish-brown, dotted all over with dark brown. Unlike most of its congeners, it does not become red by heat. Total length from the eyes to the extremity of the tail, two inches and a half.

This is one of the most abundant of the coast species of crustacea. It is taken in multitudes for the table on almost all our sandy shores, ordinarily by means of nets, which are pushed forwards by the "shrimpers," who wade nearly to their middle for hours together, raising the net at intervals, and taking out the shrimps, which are secured in a bag. In some parts of the coast, as at Poole, this species is comparatively rare, and is not used as food. The smaller Palæmonidæ are often called "shrimps," and when of small size and sold by measure they are termed "cup-shrimps." The present species is often called the sand shrimp.



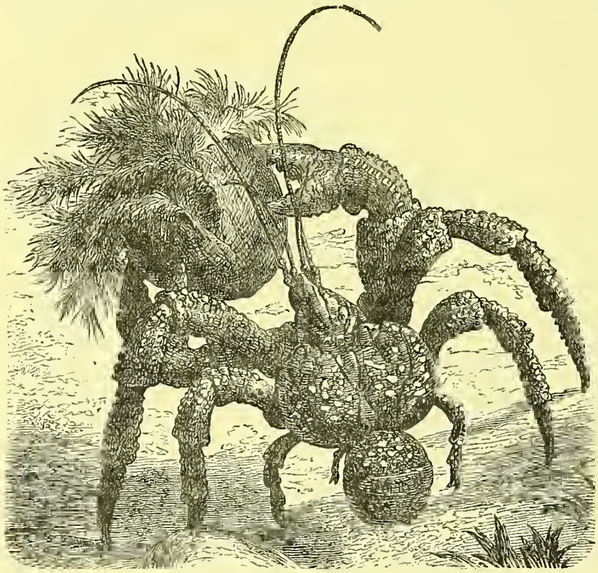
THE SHRIMP (*Palæmon vulgaris*).

In the breeding season, the shrimps approach the estuaries, and even ascend the rivers to a considerable distance.

"Although," says Mr. Thompson, "this species chiefly frequents sandy shores, I have occasionally seen it brought up in the dredge from deep water, and at a considerable distance from land, in the loughs of Strangford and Belfast. Mr. R. Ball mentions that shrimps, though taken in large quantities at Youghal, are held in little esteem; but that the prawn (*Palæmon serratus*), caught abundantly at spring-tides, is much thought of. This latter is called 'shrimp' there, the former the 'grey shrimp.' This term is also used in Smith's 'History of the County of Cork,' written nearly a century since."

"Although," writes the late Mr. Hailstone, "in general this species is very wholesome, yet instances occur in which it produces effects similar to those which sometimes follow the eating of mussels. They swim in the water, or lie upon the sand in shoals, and are taken by a large net with a semicircular mouth, which the shrimper pushes before him along the bottom of the sea during the ebb-tide. In colour they so closely resemble the sand, that, in the pools left by the tide, they are with difficulty distinguished. They are in spawn throughout the year, and cast the shell in March, April, and May."

In the second order (ANOMURA) the abdomen is small, and is often feebly developed, as in the Hermit Crabs, which live hermit-like lives each in its own shell. But these are not made by the crab, but are the cast-off habitations of some molluscs, into which the crab puts its soft body, stopping up the entrance by its big claw. The great Cocoa-nut-eating Crab (*Birgus latro*) belongs to this order. Mr. Darwin writes: "I have before alluded to a crab which lives on the cocoa-nuts; it is very common on all parts of the dry land, and grows to a monstrous size. It is closely allied, or identical with, the Birgus latro. The front pair of legs terminate in very strong and heavy pincers, and the last pair are fitted with others weaker and much narrower. It would at first be thought quite impossible for a crab to open a strong cocoa-nut covered with the husk; but Mr. Liesk assures me that he has repeatedly seen this effected. The crab begins by tearing the husk, fibre by fibre, and always from that end under which the three eye-holes are situated. When this is completed, the crab commences hammering with its heavy claws on one of the eye-holes till an opening is made. Then turning round its body, by the aid of its posterior and narrow pair of pincers, it extracts the white albuminous substance. I think this is as curious a case of instinct as ever I heard of, and likewise of adaptation in structure between two objects apparently so remote from each other in the scheme of nature as a crab and a cocoa-nut tree. The birgus is diurnal in its habits; but every night it is said to pay a visit to the sea, no doubt for the purpose of moistening its branchiæ. The young are likewise hatched, and live for some time, on the coast. These crabs inhabit deep burrows, which they hollow out beneath the roots of trees, and where they accumulate surprising quantities of the picked fibres of the cocoa-nut husk, on which they rest as on a bed. The Malays sometimes take advantage of this, and collect the fibrous mass to use as junk. These crabs are very good to eat. Moreover, under the tail of the larger ones there is a great mass of fat, which, when melted, sometimes yields as much as a quart bottle full of limpid oil. It has been stated by some authors that the birgus crawls up the cocoa-nut trees for the purpose of stealing the nuts. I very much doubt the possibility of this; but with the pandanus the task would be very much easier. I was told by Mr. Leisk that on these islands the birgus lives only on the nuts which have fallen to the ground."


THE COCOA-NUT-EATING CRAB (*Birgus latro*).

The third order (BRACHYURA) contains all the very short-tailed Decapods, such as the great Norway Crab (*Lithodes maja*), which, with a shell or carapace not exceeding six inches in diameter, has feet measuring each two feet in length; as well as the little Pea Crab (*Pinnotheres pisum*), which lives hid away between the valves of the Pinnæ, and which Cicero thought warned the big mollusc of impending dangers. Here, also, the common Land Crabs (*Gecarcinus*). They live in woods, betaking themselves to the sea by times to lay their eggs; and we must here also mention the common Edible Crab (*Cancer pagurus*) and the Shore Crab (*Carcinus mænas*).

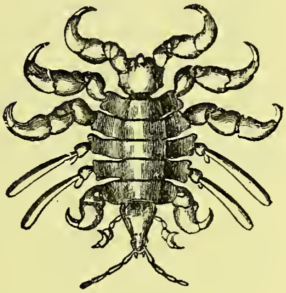
THE PEA-CRAB.

SUB-CLASS VII.—STOMATOPODA.

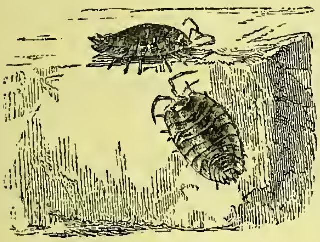
These are also marine Crustaceæ, which differ from the Decapods in not having the gills lodged in gill chambers, but affixed mostly to the caudal or body feet. Here would be placed the curious Squill, so common in the Mediterranean (*Squilla mantis*); the ocean-loving Phyllosoma, with leaf-like bodies; and the pretty little species belonging to the genus Mysis.

SUB-CLASS VIII.—EDRIOPHTHALMIA.

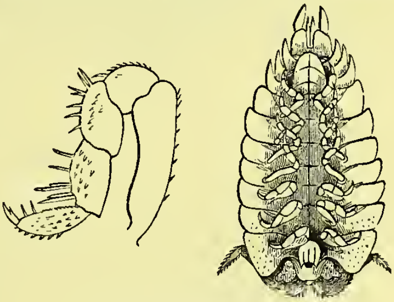
This sub-class contains an immense number of mostly small, many of them very minute Crustacea, with no stalks to their eyes; these latter compound. They very seldom have a carapace. The three principal orders are:—First, the LÆMODIPODA, containing those mantis-like forms belonging to the family of Caprellidæ, many species of which are to be found around our own shores. They attach themselves by their hind feet to marine weeds, and gracefully bend backwards and forwards in pursuit of their prey. The young ones in the same manner attach themselves to the antennæ of the parents, and form an interesting group. Here, also, are those strange parasites of the whales, the commonest species of which (*Cyamus balenarum*) we figure.

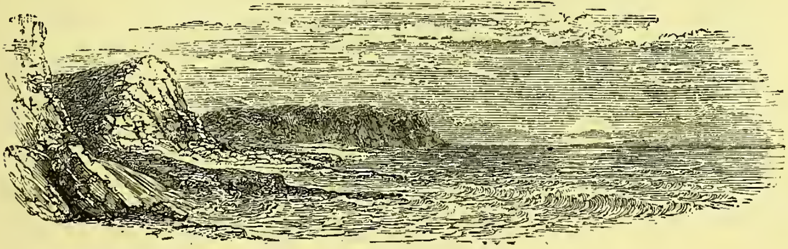

THE WHALE LOUSE.

The second order (AMPHIPODA) contains an immense number of interesting forms. Here are placed the Sand Hoppers (*Talictrus saltator*), which often are in such numbers on sandy wastes as to make the sands alive. Their power of hopping is immense, and none the less is their power of burrowing into the sand. The Fresh-water Shrimp (*Gammarus fluviatilis*) is also a well-known species; and the Deep-well Shrimp without eyes (*Niphargus fontanus*), which has been found in deep wells in England, also belongs here. Some of the species of this order are nest-builders. Some (*Chelura terebrans*) bore into submerged timber, and do great havoc on wooden jetties.


THE WOOD-LOUSE.

The third order (ISOPODA) contains even a more numerous assembly of species, some of them fresh water, some marine, and some terrestrial. Instead of having their bodies compressed, as was the case in the previous order, here the bodies are flattened, as is well seen in the common Wood-louse (Oniscus). Some of them are fish parasites (Cymothoa); others are parasitic on other Crustacea. The family of the wood-lice, or slaters (Oniscidæ), contains some of the best-known forms. The common Wood-louse (*Oniscus asellus*) is too well known to need description. It is very common throughout Great Britain and Ireland, not only in damp but also in the dryest localities. It was formerly used in medicine, being thought to cure consumption. Another species (*Platyarthus hoffmanseggii*) lives in ants' nests. The Rev. A. R. Hogan first noticed it as British. He found it in ants' nests, at Lulworth Cove, near Weymouth, where he observed it in as many as thirty nests of the common red, yellow, and black ants, whilst about twice that number of nests in the neighbourhood were not found to be frequented. It has since then been found in other places in England. The species of armadillo can roll themselves into a pill-like mass. The only British species (*Armadillo vulgaris*) inhabits dry places. In former times it was highly reputed for it medicinal virtues, and was said to be excellent in cases of jaundice, and the wine of millipedes, prepared by crushing these little animals when fresh in Rhenish wine, was an admirable clearer of all the viscera. It is said these Isopods are still used medicinally in Scotland. One large form (*Ligia oceanica*) can any day be seen on marine piers, scampering about in search of decaying animal matter; and another (*Limnoria terebrans*) destroys submerged timber in piers.


PLATYARTHUS HOFFMANSEGGII.



SUB-KINGDOM III.—MOLLUSCA.

This sub-kingdom contains an enormous number of species, many of which are among the best known of natural forms. We have only to mention a cuttle-fish, a limpet, an oyster, the common garden slug, to enable one to call to mind the general form and appearance of some of the chief types of this sub-kingdom.

The body of the animals belonging to this sub-kingdom is covered by a soft, and, during life, a constantly moist skin, to which the muscles are attached, and in which, in very many of the species, a calcareous secretion, called the shell, is laid down. This external integument, called the mantle, also encloses the alimentary and the nervous systems. In some Mollusca the head is not distinct from the rest of the body: this is chiefly the case in those with two-valved shells, constituting the large class of the Mollusca with lamellar gills. The sense organs are but feebly developed. The movements of the Mollusca are, as a rule, slow; some indeed, when adult, are immovably attached to various objects. Their respiration is, in most, by means of gills. In most a heart is present. Their blood is commonly white or of a whitish-blue. In some the sexes are united; in others they are in distinct individuals. All lay eggs, which vary much in form; often, when laid, these eggs are connected into masses. Of the nearly 19,000 species known, some 5,500 are provided with an air cavity, rich in blood-vessels, by means of which they can breathe atmospheric air directly, and these belong to an order the species of which live on the land. All the rest are aquatic, and by far the larger portion of these latter live in the sea.

The Mollusca provided with a head have been formed into a group, called the Odontophora, by Professor Huxley, because these all possess a very remarkable apparatus, armed with teeth, in their mouth (oral) cavity. This group would embrace the first three classes in the following enumeration.

The Bivalves have no trace of this organ. They constitute our fourth class, and these four classes are regarded by Professor Huxley as properly forming parts of one and the same sub-kingdom of Mollusca; and our next two classes—which, both in their nervous and blood systems, differ profoundly from the first four—he would form, adding the Polyzoa, into an independent sub-kingdom, to be called Molluscoida. While we quite incline to believe that Professor Huxley is nearly right in this, we have been led here to treat of all the six classes as if of equal value, and to relegate the Polyzoa to the sub-kingdom of the worms. This sub-kingdom may then be divided into the following classes:—

Class 1. Cephalopoda.
„ 2. Gasteropoda.
Class 3. Pteropoda.
„ 4. Lamellibranchiata.
Class 5. Brachiopoda.
„ 6. Tunicata.

CLASS I.—CEPHALOPODA.

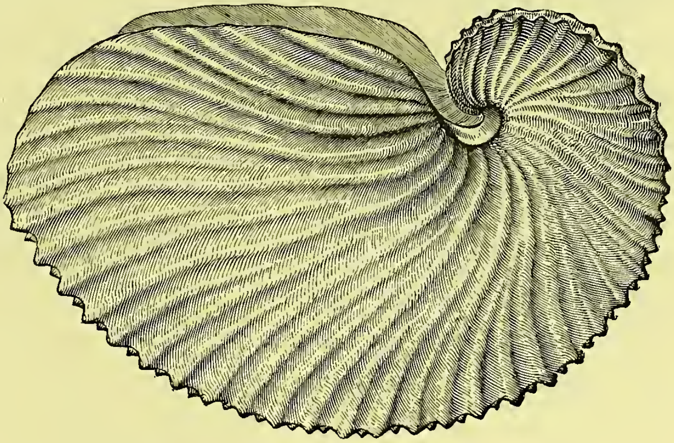
These Mollusca have distinct heads, which are round and broad, and often separated by a neck-shaped construction from the body. Around the mouth are placed, in most, either eight or ten arms. When there are eight, these stand in a circle around the mouth, and are armed on their inner surface with numerous suckers, by which the animals can attach themselves to different bodies. In the forms with ten arms, one pair is generally longer than the rest, and often somewhat differently armed. Under the head is the funnel, which is formed by an extension of the mantle, and is muscular. Below, this funnel passes into the gill cavity. The gills are either two or four in number.

The mouth lies in the middle of the arms, surrounded by a circular fold of skin, within which are two large curved horny jaws, somewhat like a parrot's bill. Between these is the membranous tongue, often beset with roughened points or covered with hard, horny plates and spines. The eyes are large. The skin is remarkable for a constant change of colour, which depends on the presence in life of a series of pigment cells. The eggs are laid in heaps or connected together in clusters; sometimes they are covered over by a dark horny envelope. Decided traces of an internal cartilaginous skeleton will be found in some of the species. In some, a calcareous plate is to be found embedded in the mantle (Sepia); in others, this plate (the pen) is of a horny consistency (Loligo). Again, in Spirula there is a calcareous spiral shell with concave partitions to be found in the posterior portion of the animal; and in Argonauta the shell is unilocular, thin, and lies covered by the expanded membrane of the uppermost two of the eight arms. In Nautilus the shell is external, many-chambered, the last chamber containing the body of the animal. All are carnivorous, and live in the sea. There are but two orders.

ORDER I.—DIBRANCHIATA.

In this order there are over 200 species known as living, and some 120 species are known as fossils. The head is distinct; the eye is large; the arms are eight or ten in number; the gills are two, from whence the name of the order; and an ink-gland is always present. This gland discharges its contents through a duct which opens near the base of the funnel. The male and female cuttle-fish are in general appearance alike; but in the male fish one of the eight arms is specially developed, so as to assist in the reproduction of the species. This wonderfully altered arm was known to Aristotle—though its full significance has been only quite recently determined—as the hectocotylus.

The cuttle-fish are generally nocturnal or crepuscular animals, concealing themselves during the day, or retiring to a lower region of the water. They inhabit every zone, and are met with near the shore as well as in the open sea, hundreds of miles from land. They attain occasionally a much greater size than any other Mollusc. MM. Quoy and Gaimard found a dead cuttle-fish in the Atlantic, under the equator, which must have weighed two hundred-weight when perfect. It was floating on the surface, and was partly devoured by birds. Banks and Solander also met with one under similar circumstances in the Pacific, which was estimated to have measured six feet in length (Owen). The arms of the Octopods are sometimes two feet long. From their habits, it is difficult to capture some species alive, but they are frequently obtained uninjured from the stomachs of dolphins and other Cetaceans which prey upon them. There are two sub-orders.



SHELL OF THE ARGONAUT.

SUB-ORDER I.—OCTOPODA.

This sub-order—that of the Octopoda—contains those forms with eight arms and with sessile suckers on these. Their bodies are round, with, very seldom, fin-like projections. There are two families. The first, ARGONAUTIDÆ, contains the well-known Paper Nautilus (*Argonauta argo*) as its type.

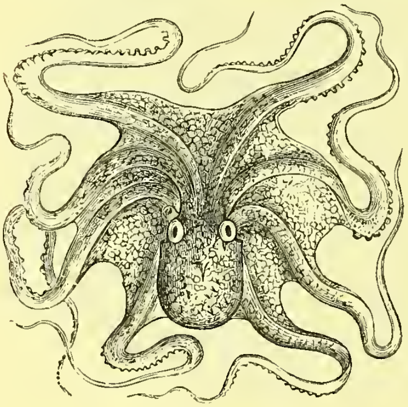
The shell of the argonaut is thin and translucent; it is not moulded on the body of the animal, nor is it attached by shell-muscles; and the unoccupied hollow of the spire serves as a receptacle for the minute cluster of eggs. The shell is believed to be peculiar to the female. Its special function is for the protection and incubation of the eggs. It is not homologous with the chambered or internal rudimental shells of other Cephalopods, but may be compared with the cocoon of the leech or the float of Ianthina. The argonaut sits in its boat with its siphon turned towards the keel, and its sail-shaped (dorsal) arms closely applied to the sides of the shell, as in the figure, where, however, they are represented as partially withdrawn, in order to show the margin of the aperture. It swims by ejecting water from its funnel, and crawls in a reversed position, carrying its shell over its back like a snail.

The male argonauts are one inch in length, and possess no shell; their dorsal arms are pointed, not expanded. The testis is large, and like that of the octopus in structure and situation; it contains spermatozoa of different degrees of development, and the excretory duct probably debouches into the hectocotylus. The sac in which the hectocotylus is developed is cleft by the movements of the hectocotylus in extending itself, while the sac becomes inverted and forms the violet-coloured capsule on its back. The sac never contains more than one hectocotylus, which is attached by its base, whilst the rest is free and coiled up. It has an enlargement like that of the Tremoctopus; the filiform appendage proceeds from the smaller extremity, and sometimes remains entangled in the coloured cyst near the base of the outer side of the hectocotylus. It has a chain of nervous ganglia in its axis.

It was the Nautilus of Aristotle, who described it as floating on the surface of the sea in fine weather, and holding out its sail-shaped arms to the breeze. It does not use its arms as sails, but it sometimes uses them as oars when it wishes to progress slowly, while floating on the surface of the sea.

Four species of the genus are known. They inhabit the open sea throughout the warmer parts of the world, and are most active during the night. Captain King took several from the stomach of a dolphin caught upwards of 600 leagues from land.

The second family, that of the OCTOPODIDÆ, contains the genera Octopus and Eledone. The common Octopod (*Octopus vulgaris*) is very often found on our coast, and is constantly to be seen in salt water aquaria. The octopods are the "polypi" of Homer and Aristotle. They are solitary animals, frequenting rocky shores, and are very active and voracious. The females deposit their eggs on seaweeds or in the cavities of empty shells. In the markets of Smyrna and Naples and the bazaars of India they are regularly exposed for sale. "Although common (at St. Jago) in the pools of water left by the retiring tide, they are not very easily caught. By means of their long arms and suckers they can drag their bodies into very narrow crevices, and when thus fixed it requires great force to remove them. At other times they dart tail first, with the rapidity of an arrow, from one side of the pool to the other, at the same instant discolouring the water with a dark chestnut-brown ink. They also escape detection by varying their tints, according to the nature of the ground over which they pass. In the dark they are slightly phosphorescent." (Darwin.) Professor E. Forbes has observed that the octopus, when resting, coils its ventral arms over its back, and seems to shadow forth the argonaut's shell.



THE OCTOPUS.

In his "Natural History of Vancouver Land," Mr. Lord tells us that "The octopus, as seen on the British coasts, although even there called a 'man-sucker' by the fishermen, is a mere Tom Thumb—a tiny dwarf—as compared to the Brobdingnagian proportions he attains in the snug bays and long inland canals along the east side of Vancouver Island, as well as on the mainland. These places afford lurking-dens, strongholds, and natural sea nurseries, where the octopus grows to an enormous size, fattens, and wages war, with insatiable voracity, on all and everything it can catch. Safe from heavy breakers, it lives as in an aquarium of smooth lake-like water, that, save in the ebbing and flowing of the tide, knows no change or disturbance.

"The ordinary resting-place of this hideous 'sea-beast' is under a large stone, or in the wide cleft of a rock, where an octopus can creep and squeeze itself with the flatness of a sand-dab, or the slipperiness of an eel. Its modes of locomotion are curious and varied: using the eight arms as paddles, and working them alternately, the central disc representing a boat, octopi row themselves along with an ease and celerity comparable to the many-oared caïque that glides over the tranquil waters of the Bosphorus. They can ramble at will over the sandy roadways intersecting their submarine parks, and, converting arms into legs, march on like a huge spider. Gymnasts of the highest order, they climb the slippery ledges, as flies walk up a window-pane; attaching the countless suckers that arm their terrible limbs to the face of the rocks, or to the wrack and sea-weed, they go about, back downwards, like marine sloths, or, clinging with one arm to the waving algæ, perform a series of trapeze movements that Leôtard might view with envy.

"Their size, of course, varies. I have seen and measured the arm five feet long, and as large at the base, where it joins the central disc, as my wrist; and were an octopus by any chance to wind its sucker-dotted cable-arms round a luckless bather, fatal would be the embrace, and horrible to imagine the being dragged down and drowned by this eight-armed monster; a worse death than being crushed by coiling serpents, like ill-fated Laocöon.

"I have often, when on the rocks in Esquimalt Harbour, watched my friends' proceedings. The water being clear and still, it is just like peering into an aquarium of huge proportions, crowded with endless varieties of curious sea-monsters; although grotesque and ugly to look at, yet all alike displaying the wondrous works of creative wisdom. In all the cosy little nooks and corners of the harbour, the great sea-wrack (*Macrocystis*) grows wildly, having a straight round stem that comes up from the bottom, often with a stalk three hundred feet long; reaching the surface, it spreads out two long tapering leaves that float upon the water. This sea-forest is the favourite hunting-ground of the octopi.

"I do not think, in its native element, an octopus often catches prey on the ground or on the rocks, but waits for them just as the spider does, only the octopus converts itself into a web, and a fearful web, too. Fastening one arm to a stout stalk, stiffening out the other seven, one would hardly know it from the wrack amongst which it is concealed. Patiently he bides his time, until presently a shoal of fish come gaily on, threading their way through the sea-trees, joyously happy, and little dreaming that this lurking monster, so artfully concealed, is close at hand. Two or three of them rub against the arms. Fatal touch! As though a powerful electric shock had passed through the fish, and suddenly knocked it senseless, so does the arm of the octopus paralyse its victim; then, winding a great sucker-clad cable round the palsied fish—as an elephant winds its trunk round anything to be conveyed to the mouth—draws the dainty morsel to the centre of the disc, where the beaked mouth seizes and soon sucks it in.

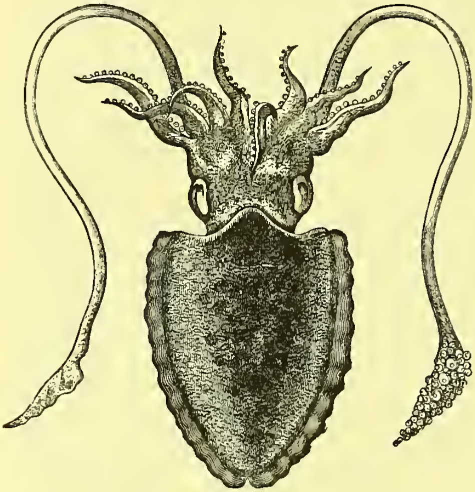
"I am perfectly sure, from frequent observation, the octopus has the power of numbing its prey; and the sucking discs along each ray are more for the purpose of climbing, and holding on whilst fishing, than for capturing and detaining slippery prisoners. The suckers are very large, and arranged in triple rows along the under surface of the ray, decreasing in size towards the point, and possessing wonderful powers of adhesion.

"As illustrating the size of these suckers, I may as well confess to a blunder I once made. It was an extremely low tide, and I was far out on the rocks at Esquimalt Harbour, hunting the pools, when I saw what I fancied a huge actinia, as big as an egg-cup, its tentacles hauled in, and, having detached its disc from the rocks, was waiting for the tide. Placing the fancied prize safely in my collecting-box, to my disgust, on examining my new species, it turned out to be only the sucking-disc of an octopus.

"Tyrants though they be, an enemy hunts them with untiring pertinacity. The Indian looks upon the octopus as an alderman does on a turtle, and devours it with equal gusto and relish, only the savage roasts the glutinous carcase instead of boiling it. His mode of catching octopi is crafty in the extreme, for redskin well knows, from past experience, that were the octopus once to get some of its huge arms over the side of the canoe, and at the same time a fast hold on the wrack, it could as easily haul it over as a child could upset a basket; but he takes care not to give a chance, and thus the Indian secures his prize.

"Paddling the canoe close to the rocks, and quietly pushing aside the wrack, the savage peers through the crystal water, until his practised eye detects an octopus, with its great rope-like arms stiffened out, waiting patiently for food. His spear is twelve feet long, armed at the end with four pieces of hard wood, made harder by being baked and charred in the fire. These project about fourteen inches beyond the spear-haft, each piece having a barb on one side, and are arranged in a circle round the spear end, and lashed firmly on with cedar-bark. Having spied out the octopus, the hunter passes the spear carefully through the water until within an inch or so of the centre disc, and then sends it in as deep as he can plunge it. Writhing with pain and passion, the octopus coils its terrible arms round the haft. Redskin, making the side of the canoe a fulcrum for his spear, keeps the struggling monster well off, and raises it to the surface of the water. He is dangerous now. If he could get a fast hold on either savage or canoe, nothing short of chopping off the arms piecemeal would be of any avail.

"But the wily redskin knows all this, and has taken care to have ready another spear, unbarbed, long, straight, smooth, and very sharp, and with this he stabs the octopus where the arms join the central disc. I suppose the spear must break down the nervous ganglions supplying motive power, as the stabbed arms lose at once strength and tenacity. The suckers, that a moment before held on with a force ten men could not have overcome, relax, and the entire rays hangs like a dead snake, a limp, lifeless mass. And thus the Indian stabs and stabs, until the octopus, deprived of all power to do harm, is dragged into the canoe, a great, inert, quivering lump of brown-looking jelly."


SEPIA OFFICINALIS.

SUB-ORDER II.—DECAPODA.

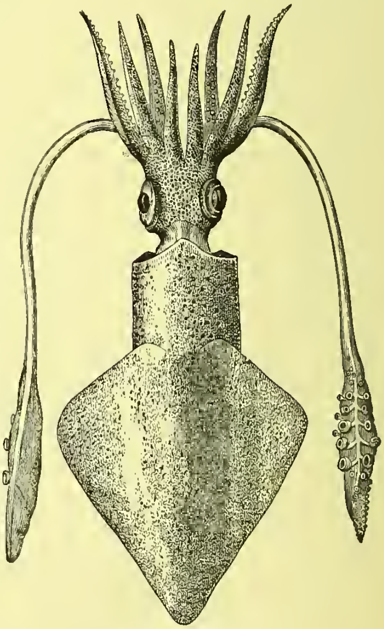
The second sub-order is that of the Decapoda, which contains the eight-armed species. The two long arms have generally expanded ends. These arms are sometimes completely retractile (Sepia); sometimes partly so (Loligo); and are non-retractile in at least one genus (Cheiroteuthis). The body is generally elongated, and provided with either a bony pen or calcareous bone.

The first family (TEUTHIDÆ) contains the Calamary (*Loligo vulgaris*). It is a good swimmer, and is often used by the fishermen for bait. The Winged Calamary (*Ommastrephes sagittatus*) is gregarious, and frequents the open sea in all climates. They are said to be extensively used in the cod fishery off Newfoundland. They are called "sea-arrows" and "flying squids" by the sailors.

The second family (SEPIADÆ) contains at least one species (*Sepia officinalis*) common around our shores: they are along-shore molluscs. The flattened form of their bodies is favourable to a coasting life, by permitting them to rest easily on the bottom. Still, they do not remain all the year round upon the coast.

They are flesh-eaters, and tolerably voracious. They feed upon fishes, molluscs, and crustaceans. They fall victims, in their turn, to the vengeful jaws of the porpoises and dolphins.

In the spring the Sepiæ deposit their eggs, but without abandoning them. On the contrary, they exhibit a truly maternal care, taking much trouble to attach them to some submarine body, in which position the temperature of the water serves to hatch the eggs. Sepia officinalis, for example, chooses, at the moment of laying, a stem of fucus, or of gorgonia, or some other solid submarine body not less in diameter than the little finger, and there it firmly attaches its eggs, which are pear-shaped—that is, pointed at one extremity; while a long lanière of a gelatinous nature, flat and black in appearance, with which they are provided, surrounds the solid body like a ring. Each female lays and attaches in this manner from twenty to thirty eggs, which are clustered together somewhat like a bunch of fine black grapes. About a month after this the eggs are hatched.


LOLIGO VULGARIS.

The colours of the Sepia officinalis vary considerably; but in general it may be remarked that the males are ornamented with deeper colours than the females. Transverse bands of a blackish-brown furrow their backs, and seem to take from their breadth. Outside of these bands are small spots of a vivid white; very near the edge there is a white border, accompanied inside with a second edging of a beautiful violet. The median and anterior parts of the body are spotted here and there; beneath, a whitish tint with reddish speckles prevails.

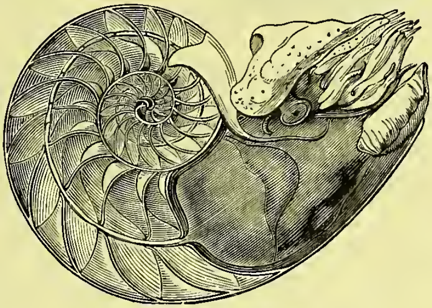
The Sepiæ are often eaten, for their flesh is savoury. They are usually fried or boiled. They form an excellent bait for large ground-fish, such as dog-fish, rays, and congers, which are fond of their flesh.

The third family—SPIRULIDÆ—contains the beautiful spiral shell known as Spirula lævis. This little delicate shell is scattered by thousands along the shores of New Zealand. It also abounds along the Atlantic coasts. Hundreds of specimens are driven ashore on the south-west coast of Spain. Some few are yearly strewn along the Devon, Cornish, and Kerry shores. But the animal was only known until recently by a few fragments. One mutilated specimen was dissected by Professor Owen in 1848. Some living examples were taken in the famous expedition of the *Challenger*, and have been given, we understand, to Professor Huxley for dissection by Sir C. Wyville Thomson.

ORDER II.—TETRABRANCHIATA.

In this order the gills are four in number. It contains probably not more than two living species, and yet more than two thousand fossil species have been described. In the first family, NAUTILIDÆ, the best known recent species is the Pearly Nautilus (*Nautilus pompilius*). It is found in the Indian Ocean, among the islands of the Moluccan Archipelago. The shell attains a size of over half a foot in width. On the inside it is whitish, with a pearly lustre, on the outside it is milk white, with red-brown stripes.

In nautilus the shell has a regularly convoluted form, the last whorl being equal to all the others. It is divided internally into numerous cells, formed by transverse partitions, concave in front and perforated towards the centre, and forming a kind of funnel, which gives passage to a syphon.

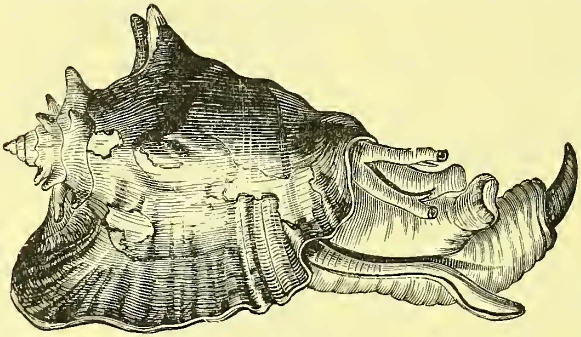

THE PEARLY NAUTILUS (SECTION OF).

In the last-formed and largest partition of the shell is the animal, covered by its mantle, which lines the walls of the partition. When it contracts itself it is protected by a sort of triangular and fleshy hood. Numerous tentacles, which are retractile, within sheaths or "digitations," corresponding to the eight ordinary arms of the cuttle-fish, and some of them furnished with numerous lamellæ, surround the head, which is, besides, scarcely distinguished from the body. The head bears two great projecting eyes, each planted upon a peduncle.

The mouth of the nautilus is armed with mandibles, fashioned somewhat like the parrot's beak. The branchiæ, as we have seen, are four in number; the circulatory system consists of a heart, with a ventricle and auricle. The shell is secreted by the outer edge of the mantle, while its posterior extremity fashions the walls of the partitions, which indicate the successive growth of the individual. The figure represents the shell of nautilus, with the animal; part of the shell is removed. It is said to be so common on the Nicobar coast that the inhabitants salt and dry its flesh, and store it as provisions. Its shell is said to be still used by the Hindoo priests as the conch with which they summon their devotees to worship. It is nearly round, smooth, transversely blazed in its posterior part, and entirely white anteriorly. A very fine nacre is yielded by this mollusc, which is much used in ornamental cabinet-work. The Orientals make drinking-cups of it, on which they engrave designs and figures, which form graceful objects. Similar vases were formerly prized in Europe, and found their way into great houses. In our days they are generally consigned to cabinets of curiosities and the shops of dealers in articles of vertu.

CLASS II.—GASTEROPODA.

THIS immense class contains more than 13,800 species. In these the head is distinct, and very generally furnished with feelers (tentacles). The lower or inferior surface of the body forms an elongated, flattened muscular disc, as is easily to be seen in the snail or slug, upon which the animal progresses. This ventral disc is known as the foot; it is sometimes laterally compressed, and then serves for swimming (as in the order of the Nucleo-branchiata). All of the species possess an odontophore. Following the system adopted in Mr. S. P. Woodward's most useful "Manual of Mollusca," we divide this class into four orders.



STROMBUS GIGAS.

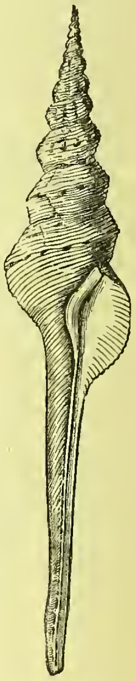
ORDER I.—PROSOBRANCHIATA.

In this order the gills are pectinated or plume-like, and are situated in advance of the heart, from whence Milne-Edwards gave the above name to the order. It contains some twenty families and over 7,500 species. A large number are carnivorous, but an also large number are phytophagous. Some few are inhabitants of fresh or brackish waters, but the large majority are marine. Some of them are of very minute size; others, like the Fountain-shell of the West Indies (*Strombus gigas*), are among the largest of living molluscs. In this order the shell is usually well developed, and the mollusc can retire into the largest or body whorl of its shell. This body whorl is, in the case of the carnivorous species of the order, prolonged into a canal, in which is lodged a siphon conducting to the respiratory chamber. This is absent in most of the vegetable feeders, and the aperture of the shell is said to be entire. The aperture of the body whorl can in many be closed by a horny or stony plate, called the operculum. With the space at our disposal it would be impossible to enumerate the various genera belonging to this order, and the following brief allusion to the principal families must suffice :—

STROMBIDÆ, or Wing-shells. These are animal feeders, and, for molluscous animals, very active. They progress by a sort of leaping movement, turning their heavy shell from side to side. Their eyes are more perfect than those of the other Gasteropods, or even of many fishes.

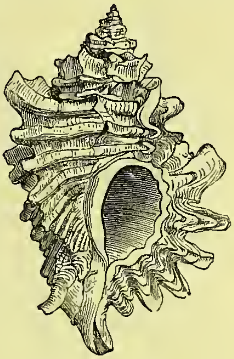
The Fountain-shell of the West Indies (*Strombus gigas*, L.) is one of the largest recent shells, weighing sometimes four or five pounds. Its apex and spines are filled up with solid shell as it becomes old. Immense quantities are annually exported from the Bahamas for the manufacture of cameos, and for the porcelain works; 300,000 were brought to Liverpool alone in the year 1850. (W. Archer.)

Fusus colosseus and F. proboscidalis (Lam.) are two of the largest living Gasteropods. Fusus (Cephrysodomus) antiguus, called the red whelk on the coasts of the Channel, and "buckie" in Scotland, is extensively dredged for the markets, being more esteemed than the whelk. It is the "roaring buckie" in which the sound of the sea may always be heard. In the Zetland cottages it is suspended horizontally and used for a lamp, the cavity containing the oil and the canal the wick. (Fleming.) The reversed variety (*F. contrarius*, Sby.) is found in the Mediterranean and on the coast of Spain. It abounds in the pliocene tertiary (crag) of Essex. The Fusus deformis, a similar species, found off Spitzbergen, is always found with the whorls reversed.



FUSUS COLOSSEUS.

MURICIDÆ, or Murices.—The Murices appear to form only one-third of a whorl annually, ending in a varix; some species form intermediate varices of less extent. M. erinaccus, a very abundant species on the coasts of the Channel, is called "sting-winkle" by fishermen, who say it makes round holes in the other shell-fish with its beak. The ancients obtained their purple dye from some species of Murex. The small shells were bruised in mortars, the animals of the larger ones taken out. Immense heaps of broken shells of the M. trunculus, and caldron-shaped holes in the rocks, may still be seen on the Tyrian shore. (Wilde.) On the coast of the Morea there is similar evidence of the employment of M. brandaris for the same purpose. (M. Boblaye.)


MUREX ERINACEUS.

BUCCINIDÆ, or Whelks.—The common Whelk (*Buccinum undatum*) is dredged for the markets or used as bait by fishermen; it may be taken in baskets baited with dead fish. Its egg capsules are mostly aggregated in roundish masses, which, when thrown ashore and drifted by the wind, resemble corallines. Each capsule contains several young, which, when hatched, show the round hole from which the fry have escaped.

Nassa obsoleta lives within the influence of fresh water, and its shell often becomes eroded. N. reticulata (L.) is common on the English shores at low water, and is called the dog-whelk by fishermen.

BUCCINUM UNDATUM.

Purpura lapillus abounds on the British coast at low water amongst seaweed. It is very destructive to mussel-beds. Many of the Purpuræ produce a fluid which gives a dull crimson dye, which may be obtained by pressing in the operculum.

Here also belongs that strange genus Magilus, which lives fixed amongst corals, and grows upwards with the growth of the zoophytes, in which they become immersed; they fill the cavity of the tube with solid shell as they advance.

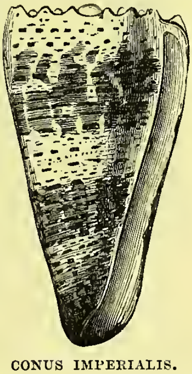
The genus Oliva is very rich in species, over 130 being described. The Olives are very active animals, and can turn over when laid on their back. Near low water they may be seen gliding about, or burying themselves in the sands as the tide retires. They may be taken with animal baits attached to lines. They range downwards to twenty-five fathoms.

CONIDÆ, or Cones.—The Cones range northward as far as the Mediterranean, and southward to the Cape, but are most abundant and varied in equatorial seas. They inhabit fissures and holes of rocks, and the warm and shallow pools inside coral reefs, ranging from low water to thirty and forty fathoms. They move slowly, and sometimes (*Conus aulicus*) bite when handled. They are all predatory.

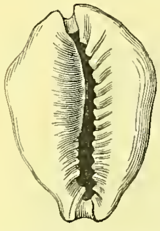
VOLUTIDÆ, or Volutes.—In Voluta the shell is ventricose, thick; spire short, apex mammillated; aperture large, deeply notched in front; columella with several plaits. V. musica and a few others have a small operculum. The animal has its eyes on lobes at the base of the tentacles; the siphon has a lobe on each side, at its base; the lingual teeth are three-cusped.

V. vespertilio and hebraea fill the nuclei of their spires with solid shell. V. brasiliana forms egg capsules over three inches long. In V. angulata the mantle is produced into a lobe on the left side, and overlaps the shell.

CYPRÆIDÆ, or Cowries, inhabit shallow water near shore, feeding on zoophytes. The young shell has a thin and sharp outer lip, with a prominent spire, and is covered with a thin epidermis. When full-grown, the mantle lobes expand on each side, and deposit a shining enamel over the whole shell, by which the spire is entirely concealed. There is usually a line of paler colour, which indicates where the mantle lobes met. Cypræa annulus is used by the Asiatic islanders to adorn their dress, to weight their fishing-nets, and also for barter. Specimens of it were found by Dr. Layard in the ruins of Nimrod. The Money-cowry (*C. moneta*) is also a native of the Pacific and Eastern seas. Many tons' weight of this little


CONUS IMPERIALIS.

shell are annually imported into this country, and again exported for barter with the native tribes of Western Africa. In the year 1848, sixty tons of the money-cowry were imported into Liverpool. Mr. Adams observed the pteropodous fry of C. annulus at Singapore adhering in masses to the mantle of the parent, or swimming in rapid gyrations or with abrupt jerking movements by means of their cephalic fins.


CYPRÆA MONETA.

NATICIDÆ.—The coloured markings of the Naticæ are very indestructible; they are frequently preserved in the fossil species. The Naticæ frequent sandy and gravelly bottoms, ranging from low water to ninety fathoms. They are carnivorous, feeding on the smaller bivalves, and are themselves devoured by the cod and haddock. Their eggs are agglutinated into a broad and short spiral band, very slightly attached, and resting free on the sands.

PYRAMELLIDÆ.—The shell is spiral-turreted; nucleus minute, sinistral; aperture small; columella sometimes with one or more prominent plaits; operculum horny, imbricated; nucleus internal. This family presents much of interest to the student of extinct mollusca. Numerous forms, bearing all the aspect of being members of this family, occur among the fossils of even the oldest stratified rocks. Many of them are gigantic compared with existing species, and the group, as a whole, may be regarded rather as appertaining to past ages than to the present epoch.

CERITHIADÆ.—In Cerithium nodulosum the shell is turreted, many-whorled, with indistinct varices; aperture small, with a tortuous canal in front; outer lip expanded, inner lip thickened; operculum horny.

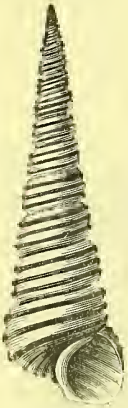
In Cerithium decollata the aperture is rounded; lip expanded, flattened. It inhabits salt marshes, mangrove swamps, and the mouths of rivers. They are so commonly out of the water as to have been taken for land-shells. Mr. Adams noticed them in the fresh waters of the interior of Borneo, creeping on Pontederia and sedges. They often suspend themselves by glutinous threads. T. telescopium is so abundant near Calcutta as to be used for burning into lime. Great heaps of it are first exposed to the sun to kill the animals. They have been brought alive to England.

CERITHIUM FASCIATUM.

MELANIADÆ.—The species of this family are often viviparous, and inhabit fresh-water lakes and rivers throughout the warmer parts of the world.

TURRITELLIDÆ.—The shell of the species in this family is tubular or spiral; upper part partitioned off; aperture simple; operculum horny, many-whorled.

Turritella imbricata is a British species. Scalaria pretiosa is the at one time rare and valuable wentletrap.

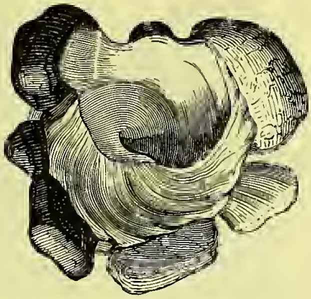

TURRITELLA ANGULATA.

LITTORINIDÆ.—The species of this family inhabit the sea or brackish water, and are mostly littoral, feeding on algæ.

The periwinkles are found on the sea-shore in all parts of the world. In the Baltic they live within the influence of fresh water, and frequently become distorted. Similar monstrosities are found in the Norwich crag. The common species (*Littorina littorea*) is oviparous; it inhabits the lowest zones of seaweed between tide-marks. An allied species (*L. rudis*) frequents a higher region, where it is scarcely reached by the tide. It is viviparous, and the young have a hard shell before their birth, in consequence of which the species is not eaten. The tongue of the periwinkle is two inches long, its foot is divided by a longitudinal line, and in walking the sides advance alternately. The periwinkle and trochus are the food of the thrush in the Hebrides during winter. The lingual canal of the periwinkle passes from the back of the mouth under the œsophagus for a short distance, then turns up on the right side, and terminates in a coil (like spare rope) resting on the plaited portion of the gullet. It is two inches and a half long, and contains about 600 rows of teeth; the part in use, arming the tongue, comprises about twenty-four rows.

The Carrier-shell (*Phorus conchyliophorus*) belongs to this family. Most of the Phori attach foreign substances to the margins of their shells as they grow, particular species affecting stones, whilst others prefer shells or corals. They are called "mineralogists" and "conchologists" by collectors. P. solaris and P. indicus are nearly or quite free from these disguises. They are said to frequent rough bottoms, and to scramble over the ground, like the strombs, rather than glide evenly.

The Looping Snails (*Truncatella*) are found on stones and seaweeds between tide-marks, and survive many weeks out of water. They walk by contracting the space between their lips and foot, like the geometric caterpillars. They are found semi-fossil along with the human skeletons in the modern limestone of Guadaloupe.



PHORUS CONCHYLIOPHORUS.

PALUDINIDÆ.—These molluscs inhabit fresh water in all parts of the world. They are viviparous, and the shells of their young are ornamented with spiral rows of cirri. The eyes are on short stalks outside the tentacles. Bithynia tentaculata is a native species which deposits its eggs on stones and aquatic plants. The female lays from thirty to seventy eggs, in a band of three rows, cleaning the surface as she proceeds; the young are hatched in three or four weeks, and attain their full growth in the second year.

The Idol-shell (*Ampullaria globosa*) inhabits lakes and rivers throughout the warmer parts of the world, retiring deep into the mud in the dry season, and is said to be capable of surviving a drought or removal from the water for many years. In the Lake Mareotis, and at the mouth of the Indus, Ampullariæ are abundant, mixed with marine shells. Their eggs are large, enclosed in capsules, and aggregated in globular masses.

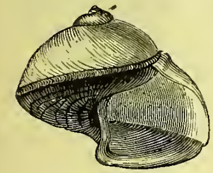
NERITINIDÆ.—The Nerites have a shell thick, semi-globose; spire very small; cavity simple, from the absorption of the internal portions of the whorls; aperture semi-lunate; columellar side expanded and flattened; outer lip acute; operculum shelly, sub-spiral, articulated.

The species of Neritina are small globular shells, ornamented with a great variety of black or purple bands and spots covered with a polished horny epidermis. They are mostly confined to the fresh waters of warm regions. One species (*N. fluviatilis*) is found in British rivers and in the brackish waters of the Baltic. Another extends its range into the brackish waters of the North American rivers; and the West Indian N. viridis and meleagris are found in the sea.

TURBINIDÆ.—The species are marine, feeding on seeweeds (algæ). The shells of nearly all the Turbinidæ are brilliantly pearly when the epidermis and outer layer of shell are removed. Many of them are used in this state for ornamental purposes.

HALIOTIDÆ.—The Ear-shells have a spiral shell, ear-shaped or trochiform; the aperture is large, nacreous; the outer lip is notched or perforated. There is no operculum. Haliotis tuberculata abounds on the shores of the Channel Islands, where it is called the ormer, and is cooked after being well beaten to make it tender. It is also eaten in Japan. It adheres very firmly to the rocks with its large foot, like the limpet. The shell is much used for inlaying and other ornamental purposes.

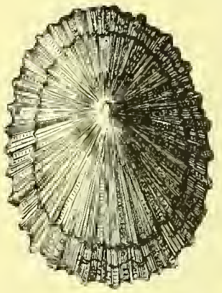
The beautiful and almost translucent Violet Snail (*Ianthina fragilis*) belongs to this family. These Ianthinæ, or oceanic snails, are gregarious in the open sea, where they are found in myriads, and are said to feed on the small blue acalephæ (*Velella*). They are frequently drifted to the southern and western British shores, especially when the wind continues long from the south-west; in Swansea Bay the animals have been found quite fresh. When handled they exude a violet fluid from beneath the margin of the mantle. In rough weather they are driven about and their floats broken or detached, in which state they are often met with. The capsules beneath the farther end of the raft have been observed to be empty at a time when those in the middle contained young with fully formed shells, and those near the animal were filled with eggs. They have no power of sinking and rising in the water. The raft, which is much too large to be withdrawn into the shell, is generally thought to be an extreme modification of the operculum; but M. Lacaze-Duthiers, who has seen the raft formed, denies this, and says that it is built up of glutinous matter secreted by the foot.



IANTHINA COMMUNIS.

FISSURELLIDÆ.—In this family the shells are conical, limpet-shaped; apex recurved;

nucleus spiral, often disappearing in the course of growth; anterior margin notched or apex perforated; muscular impression horseshoe-shaped, open in front.


PATTELLA VULGATA.

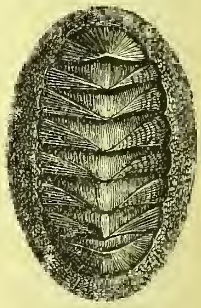
CALYPTRÆIDÆ.—The Bonnet Limpets have a shell with the apex more or less spiral; interior simple, or divided by a shelly process, variously shaped, to which the adductor muscles are attached. They are found adhering to stones and shells. Most of them appear never to quit the spot on which they first settle, as the margins of their shells become adapted to the surface beneath, whilst some wear away the space beneath their foot, and others again secrete a shelly base. Both their form and colour depend on the situation in which they grow; those found in the cavities of dead shells are nearly flat or even concave above, and colourless. They are presumed to feed on the seaweed growing round them or on animalcules; a Calyptræa, which Professor Forbes kept in a glass, ate a small sea slug (*Goniodoris*) which was confined with it. Both Calyptræa and Pileopsis sometimes cover and hatch their spawn in front of their foot.

Calyptræa sinensis, the Chinaman's Hat of collectors, is found on the southern shores of Britain. Pileopsis hungarica, the Hungarian Bonnet-shell, is found around our shores.

PATELLIDÆ.—The Limpets live on rocky coasts, between tide-marks, and are consequently left dry twice a day. They can adhere very firmly by atmospheric pressure (15 lbs. per square inch), and the difficulty of detaching them is increased by the form of the shell. On soft calcareous rocks, like the chalk of the coast of Thanet, they live in pits half an inch deep, probably formed by the carbonic acid disengaged in respiration; on hard limestones only the aged specimens are found to have worn the rock beneath, and the margin of their shell is often accommodated to the inequalities of the surrounding surface. These circumstances would seem to imply that the limpets are sedentary, and live on the seaweed within reach of their tongues, or else that they return to the same spot to roost. On the coast of Northumberland we have seen them sheltering themselves in the crevices of rocks, whose hard surfaces, overgrown with nullipores, were covered with irregular tracks, apparently rasped by the limpets in their between-tides excursions.

The Limpet (*Patella vulgata*) is much used by fishermen for bait. On the coast of Berwickshire nearly 12,000,000 have been collected yearly, until their numbers are so decreased that collecting them has become tedious. In the north of Ireland they are used for human food, especially in seasons of scarcity; many tons' weight are collected annually near the town of Larne alone. On the western coast of South America there is a limpet which attains the diameter of a foot, and the shell of which is used by the natives as a basin.

DENTALIADÆ.—The Tooth-shells are animal feeders, devouring foraminifera and minute bivalves. They are found in sand or mud, in which they often bury themselves. The British species range from ten to one hundred fathoms.

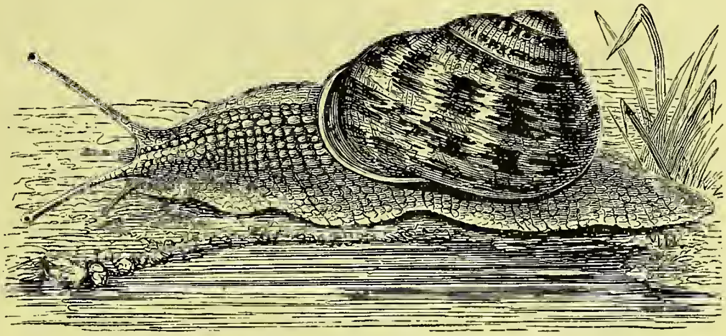

CHITON MAGNIFICUS.

CHITONIDÆ.—In the Chitons the shell is composed of eight transverse imbricating plates lodged in a coriaceous mantle, which forms an expanded margin round the body. The first seven plates have posterior apices; the eighth has its apex nearly in front. The six middle plates are each divided by lines of sculpturing into a dorsal and two lateral areas. All are inserted into the mantle of the animal by processes (apophyses) from their front margins. The posterior plate is considered homologous with the limpet-shell by Dr. Gray; the other plates appear like portions of its anterior slope successively detached. The border of the mantle is either bare or covered with minute plates, hairs, or spines.

ORDER II.—PULMONIFERA.

This order embraces all the land-snails and other mollusca which breathe air. They are normal Gasteropods, having a broad foot and usually a large spiral shell. Their breathing organ is the simplest form of lung, and is like the branchial chamber of the sea-snails, but lined with a network of respiratory vessels. One large division of the land-snails is furnished with an operculum to their shell; the rest have no operculum, and are sometimes even shell-less.

Most of them have sufficiently large shells. In the slugs, however, the shell is small and concealed, or rarely quite wanting. The greater part are terrestrial; only some of the smaller families inhabit fresh waters or damp places near the sea. Land-snails are universally distributed, but the necessity for moist air and the vegetable nature of their food favour their multiplication in warm and humid regions. They are especially abundant in islands, whilst in hot and desert countries they appear only in the season of rain or dews.

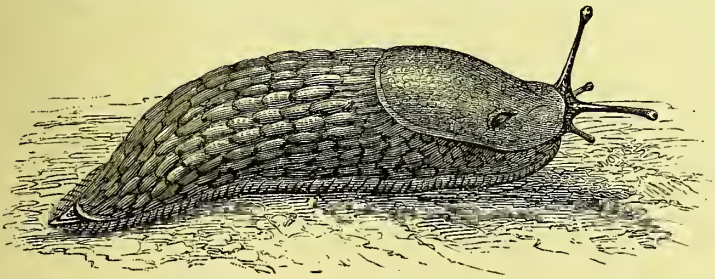


THE COMMON SNAIL (*Helix aspersa*).

SUB-ORDER I.—INOPERCULATA.

We can only allude to the following families:—HELICIDÆ.—This family contains the Land Snails. In these the shell is external and usually well developed. It is capable of containing the entire animal, and the aperture of the shell is closed by a covering of thickened mucus, or epiphragm, during hibernation. The animal has a short retractile head, with four cylindrical retractile tentacles, the upper pair longest and bearing eye-specks at their summits. Above 1,600 species are known. Their distribution is world-wide, ranging northward as far as the limit of trees, and southward to Tierra del Fuego; but they are most abundant by far in warm and humid climates. M. D'Orbigny observed six species at elevations exceeding 11,000 feet in South America; and Mr. Layard found a species (*H. gardeneri*) at the height of 8,000 feet in Ceylon. The species of tropical and southern islands are mostly peculiar. Several of the smaller British species, and even the large Garden Snail (*H. aspersa*), have been naturalised in the most remote colonies. The Neapolitans and Brazilians eat snails. The species often eaten on the Continent is the so-called Edible Snail (*H. hortensis*). One species of Bulimus (*B. ovatus*) attains a length of six inches. It is sold in the market at Rio. It lays its eggs among dead leaves, and the young, when hatched out, are an inch long.

LIMACIDÆ.—This family contains the Slugs. In these the shell is either small or rudimentary, usually internal or partly concealed by the mantle, and placed over the respiratory cavity. The animal is elongated; the body not distinct from the foot; the head and the tentacles are retractile. The slugs are closely connected with the snails. Their teeth are similar, but have more elongated cusps. The creeping-disc, or sole of the foot, extends the whole length of the animal; but they frequently lift up their heads, like the snails, and move their tentacles in search of objects above them. They often climb trees, and some can lower themselves to the ground by a mucous thread. Slugs feed chiefly on fresh or decaying vegetable substances. They lay their eggs at any time of the spring and summer, when the weather is moist, and they hide or bury themselves in



THE SLUG (*Limax rufus*).

drought and frost. They are often very destructive to young plants and ripening fruits, the quantity they can consume being often enormous; and they will often perform long journeys to feed upon a crop of strawberries or demolish a bed of young lettuce.

TESTACELLA HALIOTIDES.

In Testacella haliotides, a South European species, sometimes introduced into our gardens, the shell is ear-shaped, and is situated on the posterior extremity of the body.

ONCIDIADÆ.—The species of this family are mostly tropical. They are slug-like, but the mantle is very leathery. The typical Oncidia live on aquatic plants in the marshes of the warmer parts of the Old World. Those which frequent sea-shores have been separated under the name Peronia. One species (*O. celticum*) is found on the coast of Cornwall, congregated in little groups about a foot or two from the margin of the sea, where the waves break over them. They ascend and descend, so as to maintain their distance as the tides rise and fall; but they will not bear long immersion in sea-water. (Couch.)

LIMNÆIDÆ.—The fresh-water snails form a pretty large family. Their shells are generally thin and horny. The animals are capable of swimming, with their shells down, on the surface of the water; they feed chiefly on decaying vegetable matter; they lay their eggs in long semi-transparent masses, attached to water plants or to stones; they pass the winter in the mud.

The fresh-water snails (and also Neritina) can lower themselves from aquatic plants by a mucous thread, and re-ascend by the same. Some species of Physa can be lifted out of the water by their threads.

SUB-ORDER II.—OPERCULATA.

The shell in the species belonging to this section is generally spiral. It is closed by an operculum resembling that so frequently met with in the species of the first order. There are but the two following families.

CYCLOSTOMIDÆ.—In this family the shell is spiral and rarely much elongated: it is often depressed and spirally striated; the aperture is nearly circular; the peristome is simple. The operculum is distinctly spiral; the animal has the eyes on slight prominences at the outer bases of the tentacles; the tentacles are contractile only; and the foot is rather elongated. There is but one British species—Cyclostoma elegans; but there are nearly two hundred species of this very genus scattered through Europe and Africa. The species of the genus Cyclophorus are in great part Asiatic.

ACICULIDÆ.—One species of this family (*Acicula fusca*) is a native of Britain, and the other species of this genus (Acicula) are European; while the species of the other genus of this family, Geomelania, are only to be found in Jamaica.

ORDER III.—OPISTHOBRANCHIATA.

In this order the shell is rudimentary or wanting. The branchiæ are arborescent or fasciculated, not contained in a special cavity, but more or less completely exposed on the back and sides, towards the rear (opisthen) of the body.

The molluscs of this order may be termed sea-slugs, since the shell, when it exists, is usually small and thin, and wholly or partially concealed by the animal. When alarmed or removed from their native element, they retract their gills and tentacles, and present such a questionable shape that the inexperienced naturalist will be likely enough to return them, with the refuse of the dredge, into the sea. Their internal structure presents many points of interest. In some the gizzard is armed with horny spines or large shelly plates; in others the stomach is extremely complicated, its ramifications and those of the liver being prolonged into the papillæ, which are said to be branches of the respiratory organ. The tongue is always armed, but the number and arrangement of the lingual teeth is exceedingly variable, even in the same family; usually the dental membrane is broad and short, with many similar teeth in each row.

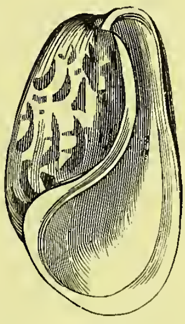
Comparatively little is known of the geographical distribution of these animals; they have been found wherever the requisite search has been made for them, and are probably much more numerous than at present estimated. Considerable additions, however, have been made to our knowledge on this subject by the researches of Kelaart in Ceylon and A. Adams in the Chinese seas, and of P. Abraham. The shell-bearing genera flourished in the period when the secondary strata were deposited. The living species are chiefly animal-feeders, preying on other shell-fish and on zoophytes.

SUB-ORDER I.—TECTIBRANCHIATA.

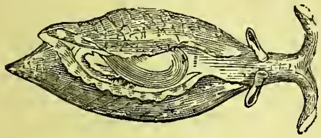
Of the families belonging to this section we can only quote the following, all of which have the branchiæ covered by a shell or the mantle:—

Tornatellidæ.—The shells of this family are chiefly extinct, ranging from the period of the coal strata, and attaining their greatest development in the cretaceous age. Tornatella is essentially related to Bulla, but presents some resemblance to the Pyramidellidæ in its plaited and operculated aperture; in Tornatina the nucleus, or apex, is sinistral. The spiral striæ which ornament many of the species are punctate, as in the Bullidæ; and the outer lip often remarkably thickened, as in Auricula. Tornatella tornatilis inhabits deep water—60 fathoms.

Bullidæ. — These are animal-feeders. They have wing-like expansions to their heads, supposed to be formed by the fusion of the dorsal and oral tentacles, which they can use to a certain extent in swimming.


SCAPHANDER LIGNARIUS.

Aplysiadæ.—In this family the shell is wanting or rudimentary, and covered by the mantle. It is oblong, trigonal, or slightly convoluted. The animal is slug-like, with distinct head, tentacles, and eyes; foot long, drawn out into a point behind; sides with extensive lobes, reflected over the back and shell; branchial plume concealed. Sexes united. The sea-hares are mixed feeders, living chiefly on seaweed, but also devouring animal substances. They inhabit the laminarian zone, and deposit their eggs amongst the weed in spring, at which time they are frequently gregarious. They are perfectly harmless animals, and may be handled with impunity. When molested they discharge a violet fluid from the edge of the internal surface of the mantle, which does not injure the skin, has but a faint smell, and changes to wine-red. In old times they were objects of superstitious dread, on account of their grotesque forms and the imaginary properties of this fluid, which was held to be poisonous and to produce indelible stains.


APLYSIA HYBRIDA.

Pleurobranchidæ.—In this family the shell is limpet-like or concealed, rarely wanting; the mantle or shell covers the back of the animal; the gill is lateral between the mantle-margin and foot; their food is vegetable, and they have an extremely complicated stomach.

In the Chinese Umbrella-shell (*Umbrella umbellata*) the shell is limpet-like, orbicular, depressed, marked by concentric lines of growth. The apex is sub-central, oblique, scarcely raised; the margins are acute. The inner surface has a central coloured and striated disc, surrounded by a continuous irregular muscular impression. It has a minute sinistral nucleus. The animal has a very large tuberculated foot, deeply notched in front; its mouth is small, proboscidiform, retractile into the pedal notch, covered by a small-lobed veil; the dorsal tentacles are ear-shaped, with large plicated cavities at their bases; the eyes are small, sessile between the tentacles; the mantle does not extend beyond the shell; the gill forms a series of plumes beneath the shell in front and on the right side; the reproductive organs are in front of the dorsal tentacles; and the excretory orifice is posterior and tubular.

Phyllidæ.—In this family the animal is shell-less and covered by a mantle; branchial laminæ are arranged in series on both sides of the body, between the foot and mantle. The sexes are united.

SUB-ORDER II.—NUDIBRANCHIATA.

The animals belonging to this section are destitute of a shell, except in the embryo state. The branchiæ are always external, on the back or sides of the body. The sexes are united. The Nudibranchiate sea-slugs are found on all coasts where the bottom is firm or rocky, from between tide-marks to a depth of fifty fathoms; a few species are pelagic, crawling on the stems and fronds of floating seaweed. They have been found by Middendorff in the Icy Sea, at Sitka, and in the Sea of Ochotsk; in the tropical and southern seas they are abundant. No satisfactory account, however, has been published of any, except the European, and especially the British species, which form the subject of an admirable monograph by Messrs. Alder and Handcock in the publications of the Ray Society. They require to be watched and drawn whilst living and active, since after immersion in spirits they lose both their form and colour. In some the back is covered with a cloak or mantle, which contains calcareous spicules of various forms, sometimes so abundant as to form a hard, shield-like crust. The dorsal tentacles and gills pass through holes in the cloak, somewhat like the "key-hole" in Fissurella. In others there is no trace of a mantle whatever. The eyes appear as minute black dots immersed in the skin, behind the tentacles; they are well organised and conspicuous in the young, but often invisible in the adult. The dorsal tentacles are laminated, like the antennæ of many insects; they are never used as organs of touch, and are supplied with nerves from the olfactory ganglia. The nervous centres are often conspicuous by their bright orange colour; they are concentrated above the œsophagus. Three pairs are larger than the rest: the cerebroid in front, the branchial behind, and the pedal ganglia at the sides. The cerebroid supplies nerves to the tentacles, mouth, and lips.

The digestive organs of these animals present two very remarkable modifications: in Doris and Tritonia the liver is compact and the stomach a simple membranous sac; whilst in Æolis the liver is disintegrated, and its canals so large that the process of digestion must be chiefly carried on in them, and they are regarded as cœcal prolongations of the stomach. The cœca extend into a series of gill-like processes, arranged upon the back of the animal, which also contain part or the whole of the true liver; the gastric ramifications vary exceedingly in amount of complexity.

The vascular system and circulation of the Nudibranchiate molluscs is incomplete. In Doris, veins can be traced only in the liver and skin; the greater part of the blood from the arteries escapes into the visceral sinus and into a network of sinuses in the skin, from which it returns to the auricle by two lateral veins, without having circulated through the gills. The heart is contained in a pericardium, to which is attached a small ventricle, or portal heart, for impelling blood to the liver; the hepatic veins run side by side with the arteries, and open into a circular vein, surrounding the vent and supplying the gills. Only hepatic blood, therefore, circulates through the gills. In Æolis there are no special gills, but the gastro-hepatic papillæ are accompanied by veins which transmit blood to the auricle. The skin acts as an accessory breathing organ; it performs this function entirely in the Elysiadæ, and in the other families when by accident the branchiæ are destroyed. The water on the gills is renewed by ciliary action. The fry is provided with a transparent nautilus-like shell, closed by an operculum, and swim with a lobed head-veil fringed with cilia, like the young of most other Gasteropods.

Dorididæ.—The Dorids vary in length from three lines to more than three inches. They feed on zoophytes and sponges, and are most plentiful on rocky coasts, near low water, but range as low as twenty-five fathoms. They occur in all seas, from Norway to the Pacific.

Tritonidæ.—In this family the animals are provided with laminated, plumose, or papillose gills, arranged along the sides of the back; the tentacles are retractile into sheaths; the lingual membrane with central and numerous lateral teeth; the orifices are on the right side.

Eolidæ.—In this family the animal is provided with papillose gills, arranged along the sides of the back; tentacles sheathless, non-retractile; ramifications of the stomach and liver extending into the dorsal papillæ; excretory orifices on the right side; skin smooth, without spicula; no distinct mantle.

There are of the genus Eolis over thirty-three species known, found in Norway, Britain, the United States, Mediterranean, South Atlantic, Pacific. They occur amongst rocks at low water. They are active animals, moving their tentacles continually, and extending and contracting their papillæ; they swim readily at the surface, with the gills down. They feed chiefly on sertularian zoophytes, and if kept fasting will devour each other; when irritated, they discharge a fluid from their papillæ, which at the same time are very liable to fall off.

ORDER IV.—NUCLEOBRANCHIATA.

The present order consists entirely of pelagic animals, which swim at the surface, instead of creeping on the bed of the sea. Their rank and affinities seem to many to entitle them to the first place in the class; but their extremely aberrant form and unusual mode of progression have caused us to postpone their description till after that of the ordinary and more typical Gasteropoda.

There are two families of nucleobranchiate molluscs: the Firolas and Carinarias, with large bodies and small or no shells; and the Atlantas, which can retire into their shells and close them with an operculum. Both animal and shell are symmetrical, or nearly so; the nucleus of the shell is minute and dextrally spiral.

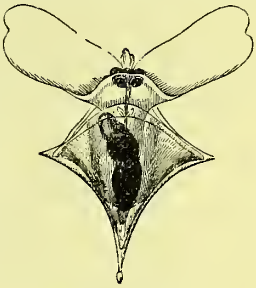
Such delicate and transparent creatures would hardly seem to need any special breathing organ, and, in fact, it is present or absent in species of the same genus, and even in specimens of the same species. Carinaria has fully-formed branchiæ; in Atlanta they are sometimes distinct, and wanting in others; in Firoloides they are only indicated by a ciliated sub-spiral band. The larvæ are furnished with a shell and with ciliated vela.

ATLANTIDÆ.—In the species belonging to this family the animal is furnished with a well-developed shell, into which it can retire. In the genus Atlanta the shell is minute, glassy, flattened, and with a very conspicuous keel. There are some twenty species known living. They frequent the warmer parts of the Atlantic. The operculum has a right-hand spiral coil, and is thought to be the only instance among the Mollusca of a dextral shell being also provided with a dextral operculum.

FIROLIDÆ.—In this family the species have scarcely any shell: this only sufficing to cover and protect the gills or branchiæ. The animal is long and translucent. One species, Carinaria cristata, is well known in the Mediterranean and other parts of the Atlantic and Indian Oceans. It feeds on small Acalephæ, and probably on the Pteropoda.

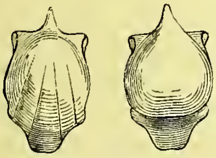
CLASS III.—PTEROPODA.

THIS is the smallest of the classes of the Mollusca, and it contains only oceanic forms. There are not quite a hundred species known, and these all pass their lives in the open ocean far away from the shelter of any land. In appearance they bear some resemblance to the very young swimming stages of the Gasteropods. They are of small size, extreme delicacy, and occur often in immense shoals. These shoals are to be met with equally in the Arctic seas, where they are engulfed by the whales, and in the warm tropical seas. Some come to the surface before or at sunrise, others are to be found there all through the summer's day. Some of the larger species have little prehensile feelers, and feed upon small crustacea. As the animals die their tiny and fragile shells sink to the depths of the ocean, and so add to the fine deposits there ever going on. Although found in the older rocks (Conularia), yet they are by no means common in a fossil state.


CLEODORA PYRAMIDATA.

The true foot is almost wanting in the species of this class, though in some it is probably continued with little fin-like bodies (Cleodora), and it is fairly distinct in others (Clio). These fins are supposed to be the equivalents for the side lappets of the sea snails.

The Pteropods have a well-organised alimentary system, consisting of a muscular gizzard-like stomach, a liver, and a pyloric cæcum. The heart consists of two chambers. The respiratory organ consists of little more than a mere ciliated surface, sometimes lodged in a branchial chamber and sometimes not. The shell when present is small, glossy, and symmetrical, either conical in shape or spirally coiled. There are three families.


HYALEA TRIDENTATA.

HYALEIDÆ.—One species (*Hyalea tridentata*), with several other species of this genus, is found in the Atlantic Ocean. Clio pyramidata is another species. Rang says he has seen Creseis aciculata clustering around floating seaweed. The second family, LIMACINIDÆ, has got minute spiral shells, sinistral, but otherwise like little snail shells. One of the best known species is Limacina antarctica.

The second section is called Gymnosomata, the animals being naked; this contains the family CLIIDÆ. Clio borealis was apparently the only Pteropod known to Linnæus. It abounds in the Arctic and Antarctic Seas. Scoresby says that in swimming this species brings the ends of its fins almost in contact, first above and then below.

CLASS IV.—LAMELLIBRANCHIATA.

The bivalve shell-fish—or Conchifera, as they were called by Lamarck—are familiar to every one under the form of oysters, scallops, mussels, and cockles. They come next to the univalves (Gasteropoda) in variety and importance, and though less numerous specifically, are far more abundant individually. About 4,500 species have been described. The bivalves are all aquatic, and, excepting a few widely-dispersed and prolific genera, are all inhabitants of the sea. They are found on every coast and in every climate, ranging from low water-mark to a depth of more than two hundred fathoms. In their native element, the oyster and scallop lie on one side, and the lower valve is deeper and more capacious than the upper; in these the foot is wanting or else small, and is not used for locomotion. Most other bivalves live in an erect position, resting on the edge of their shells, which are of equal size. Those which move about much, like the river mussel, maintain themselves nearly horizontally, and their keel-shaped foot is adapted for ploughing through sand or mud. The position of those bivalves which live half-buried in river-beds or at the bottom of the sea is often indicated by the darker colour of the part exposed, or by deposits of tufa or the growth of seaweed on the projecting ends of the valves. In Nucula and some others the foot is deeply cleft, and capable of expanding into a disc, like that on which the snails glide; whilst in the mussel, pearl-oyster, and others which habitually spin a byssus, the foot is finger-like and grooved. The burrowing species have a strong and stout foot, with which they bore vertically into the sea-bed, often to a depth far exceeding the length of their valves. These never voluntarily quit their abodes, and often become buried and even fossilised in them. They most usually burrow in soft ground, but also in coarse gravel, in firm sands and clays, in wood, and in rocks. One small modiola makes its nest in the cellulose tunic of Ascidians, and another in floating blubber.

Examined by the microscope, the gill laminæ appear to be a network of blood-vessels, whose pores, opening into the gill-tubes, are fringed with vibratile cilia. These microscopic organs perform most important offices: they create the currents of water, arrest the floating particles, and mould them, mixed with the viscid secretion of the surface, into threads in the furrows of the gill, and propel them along the grooved edge of its free margin in the direction of the mouth; they are then received between the palpi in the form of ravelled threads (Alder and Hancock). In the river-mussel the gills are not united to the body, but a slit is left by which water might pass into the dorsal channel, were it not for the close apposition of the parts under ordinary circumstances. The gills of the oyster are united throughout by their bases to each other and to the mantle, completely separating the branchial cavity from the cloaca. In the scallop the gills and mantle are free, but the "dorsal channels" still exist, and carry out the filtered water. In some genera the gills subserve a third purpose; the oviducts open into the dorsal channels, and the eggs are received into the gill-tubes, and retained there until they are hatched. In the river-mussel the outer gills only receive the eggs, with which they are completely distended in the winter months. The valves of the Conchifera are bound together by an elastic ligament, and articulated by a hinge furnished with interlocking teeth. The shell is closed by powerful adductor muscles, but opens spontaneously by the action of the ligament, when the animal relaxes and after it is dead.

Section A.—Asiphonida. (*Without Siphons.*)

The molluscs belonging to this section are not provided with siphons for respiration. Their mantle lobes are free, or only united at the place which divides the branchial chamber from the exhalent one. The shell is often pearly, or covered with a shining nacreous substance on the inside. The following are some of the families :—

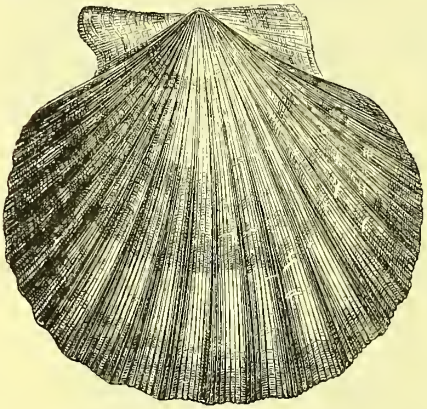
OSTREIDÆ.—In the oysters the shell is inequivalve, slightly inequilateral, free or adherent, resting on one valve; the beaks of the shell are central, straight; the ligament is internal; the epidermis is thin; the adductor impression is single, and behind the centre; the pallial line is obscure; the hinge is usually toothless. The interior of recent oyster-shells has a slightly nacreous lustre. In fossil specimens an irregular cellular structure is often very apparent on decomposed or fractured surfaces. Fossil oysters which have grown upon Ammonites, Trigoniæ, &c., frequently take the form of those shells.

In the "cockscomb" oysters both valves are plaited. O. diluviana sends out long root-like processes from its lower valve. The "Tree Oyster" (*Dendrostrea*, Sw.) grows on the roots of the mangrove. Oyster-shells become very thick with age, especially in rough water. The fossil oyster of the Tagus (*O. longirostris*) attains a length of two feet. The greatest enemy of oyster-banks seems to be a sponge (Cliona), which eats into the valves, both of the dead and living shells; at first it makes only small round holes at irregular intervals, and these are often disposed in regular patterns, but ultimately the shell is completely mined and falls to pieces. Natural oyster-banks usually occur in water several fathoms deep. The oysters spawn in May and June, and the fry ("spats") are then extensively collected and removed to artificial feeding-grounds, or tanks where the water is very shallow. They are then called "natives," and do not attain their full growth in less than five or seven years, whilst the "sea-oysters" are full-grown in four years. Native oysters do not breed freely, and sometimes many die in the spawning season; they are also liable to be killed by frost. The season is from the end of August to the end of April. From 20,000 to 30,000 bushels of "natives," and 100,000 bushels of sea-oysters are annually sent to the London market. Many other species of oysters are eaten in India, China, Australia, &c. "Green oysters" are those the gills of which have acquired this colour by feeding on several minute green algæ.

The Scallop (*Pecten maximus*) and "Quin" (*P. opercularis*) are esteemed delicacies. The latter covers extensive banks, especially on the north and west of Ireland, in fifteen to twenty-five fathoms water. The scallop ranges from three to forty fathoms. Its body is of a bright orange or scarlet colour; the mantle is of a fawn colour, marbled with brown. The shell is often used for "scalloping" oysters; formerly it was employed as a drinking-cup, and it is celebrated as such in Ossian's "Hall of Shells." An allied species has received the name of "St. James's Shell (*P. Jacobæus*). It was worn by pilgrims to the Holy Land, and became the badge of several orders of knighthood. Most of the Pectens can spin a byssus when young, and some, like P. varius, do so habitually. P. niveus moors itself to the fronds of the tangle (Laminaria). The Rev. D. Landsborough observed the fry of P. opercularis, when less than the size of a sixpence, swimming in a pool of sea-water left by the ebbing of the tide. "Their motion was rapid and zig-zag; they seemed, by the sudden opening and closing of their valves, to have the power of darting like an arrow through the water. One jerk carried them some yards, and then by another sudden jerk they were off in a moment on a different tack."

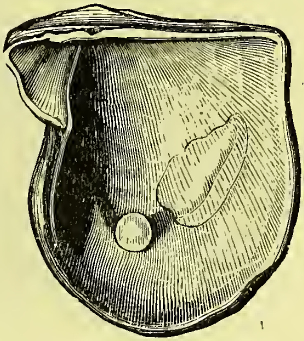
OYSTERS.

But it is not only the fry that can thus swim, for Mr. Gosse tells us:—"I have before me a small specimen of *Pecten opercularis*, which I have kept for some days in a glass phial of sea-water. The transparency of the vessel enables me to observe it and to watch its motions with advantage. An object of unwonted beauty indeed it is. Its ordinary condition is to lie with its valves separated to the distance of about one-sixth of an inch. In this state I will describe it. The open space is occupied by what seems a fleshy cushion, extending from one valve to the other all round, but just within their edge. It is of a delicate flesh-colour, with mottlings of dark brown, making a kind of irregular pattern with transverse bands. A close examination, however, shows that this substance is divided into two parts; for when the animal is quite at ease, it is seen to gape with a fissure parallel to the valves, widely enough to give us a peep into the internal structure. This is, in fact, the mantle, of which these two parts are the thick and glandular edges. Around its circumference, on each portion, just where it is in contact with the valve, there are set a great number of tentacles—delicate thread-like organs, tapering to a fine point, and of a pellucid white appearance. They are capable of being protruded and retracted at the will of the animal. I have occasionally seen some of them extended to a length equal to the diameter of the shell. They are more commonly contracted to about one-fourth of the length, or even much less, with the points turned up; but frequently the animal protrudes them to their utmost extent, bending them back over the edges of the shells, and waving them slowly in every direction. Sometimes one or two only are protruded, and the others kept short. Along the very edge of each division of the mantle, bordering the fissure, is another row of similar tentacles, smaller in their dimensions. But the most beautiful feature of this animal is yet to be described. In the line of the larger tentacles, and alternating with them, is seen a row of minute circular points, of high refractive power, possessing all the brilliancy of precious stones. They look, indeed, like diamonds of the first water, each set in a ring or socket of black substance, which greatly enhances their beauty. They are about half as numerous again as the radiating grooves of the shell, but are not set with perfect regularity. They are still less uniform in size, some having a diameter twice as great as others. These are believed to be eyes, and certainly they are well placed for enabling the animal to watch the world around it. It is very sensitive, withdrawing its tentacles and mantle, and bringing the valves of its shell together on any shock being given to the vessel in which it is kept. I observe, however, that it will not actually close the valves, unless it be repeatedly disturbed, or unless the shock be violent, contenting itself with narrowing the opening to the smallest space appreciable; yet, even then, the two rows of gem-like eyes are distinctly visible peering out from the almost closed shell, the two appearing like one undulating row from the closeness of their contiguity. Those who are familiar with the pincushions, so frequently made between the valves of these very scallop shells, can hardly fail to be struck with the resemblance borne by the living animal to its homely but useful substitute; and the beautiful eyes themselves might be readily mistaken for two rows of diamond-headed pins, carefully and regularly stuck along the two edges of the pincushion. A friend, to whom I showed it when nearly closed, compared it, not unaptly, to a lady's ring set with small brilliants.



THE SCALLOP (*Pecten maximus*).

"My attention was called to the pecten by this curious circumstance—that it was adhering by one valve (the flat one) to the side of the glass phial, at some distance from the bottom. On close examination with a lens I discovered that it was attached by a very delicate byssus. Curious to ascertain how it contrived to mount from the bottom to this position, I touched it slightly and caused it to loose its hold. In the course of half an hour I found that it had resumed the same position again. I again disturbed it, and began to watch its motions. It was lying with the convex valve downwards on the bottom of the phial. The first thing that I observed was the thrusting forth of the delicate little foot, an organ which seemed to me appropriately named, when I marked its close resemblance in form to a human foot and leg, enveloped in a white stocking. What I may call the sole of this tiny foot was pressed against the side of the glass, feeling about from place to place, while with the lens I could distinctly see, in the part corresponding to the toe, the opening of the fleshy lips, or sides of the grooves, in which the threads of byssus are said to be formed. While it was thus engaged my surprise was excited by seeing it suddenly throw itself with a jerk into an upright position; but the action was too startling to enable me to see how it was performed. I again laid it prone, and though for a moment it closed the valves, it presently opened them again and performed a similar feat. This was followed by several leaps in different directions, in quick succession; but I was still at a loss to know the *modus operandi.* It appeared to me certain that the ordinary supposition, viz., that the action is performed by the vigorous opening and shutting of the valves, was not the correct one. At length a favourable observation gave me a suspicion of the truth. I perceived the lips of the mantle (which were held in contact, though the valves were considerably separated) suddenly open to a partial extent, as if from a blowing from within. At this instant there was a leap in the opposite direction, attended with a considerable agitation in the water. With this clue, I observed more definitely. Having rendered the water a little turbid, in order the more distinctly to see any motion of the particles suspended in it, several leaps confirmed the notion that had suggested itself to me. The mode of proceeding is as follows :—When the pecten is about to leap, it draws in as much water as it can contain within the mantle, while the lips are held firmly in contact. At this instant the united edges of the lips are slightly drawn inwards, and this action gives sure warning of the coming leap. The moment after this is observed the animal, doubtless by muscular contraction, exerts a strong force upon the contained water, while it relaxes the forced contact of the lips at any point of the circumference, according to its pleasure. The result is the forcible ejection of a jet of water from that point, which, by the resilience of its impact upon the surrounding fluid, throws the animal in the opposite direction, with a force proportioned to that of the *jet d'eau.* The action may be well imitated by the human mouth blowing a stream of air from any determined point, while the lips are held firmly together at all other points. The resemblance, indeed, of the mantle to the human lips performing such an action (a resemblance perhaps more close than flattering) struck me as ludicrously faithful. Nor was the appearance less suggestive of a pair of bellows without a nose, of which the valves were the covers, and the mantle the leathers, discharging their contents from any part of their sides.



MELEAGRINA MARGARITIFERA.

"That the pecten widely opens and forcibly closes its valves, if left uncovered by the water, is doubtless correct. I have seen my specimen perform such an action, and, perhaps, it might by such means jerk itself from place to place with considerable agility. But I do not think so rude a mode of progression could enable it to select the direction of its leaps, which under water appears to me to be determined with accurate precision.

"I observed also a fact which appeared confirmatory of the supposition that the brilliant points among the tentacles are organs of vision, viz., that in the ordinary state of expansion, and when about to make these quick movements, the gem-like points are so situated as just to project beyond the margin of the shell. So that when the latter is viewed perpendicularly, the eye of the beholder looking down upon its convexity, the minute points are seen all round its circumference, just, and but just, peeping from under its edge. It is clear that if they are eyes, this secures to them the widest range of vision with the least possible exposure.

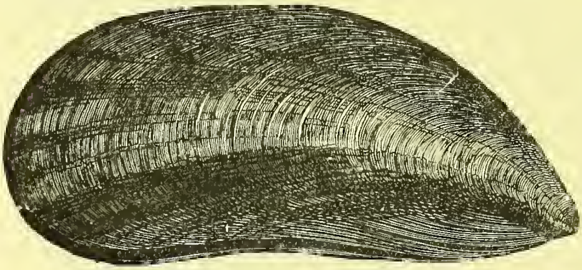
"The death of my little pecten gave me the opportunity of submitting some ot the gemmeous specks to the microscope. With a power of 220 diameters, I distinctly perceived a large lens, a glassy coat investing this, which itself was buried for more than half its volume in an investiture apparently granular, of a yellowish-brown colour, having an ill-defined circle near its anterior side, of a blackish hue. Under pressure with the compressorium, the lens was manifestly circular; the coloured socket discharged dark granules, and from the darkest part a deep crimson pigment, which did not appear to be granular."

AVICULIDÆ.—In this family the shells are very inequivalve, the posterior umbone being wing-like. The wing-shells, or pearl-oysters, are natives of tropical and temperate seas. There are no living species in northern latitudes, where fossil forms are, however, very numerous.

The "Pearl Oysters" (*Meleagrina margaritifera*) are less oblique than many of the other species of the family, and their valves are flatter and nearly equal; the posterior pedal impression is blended with that of the great adductor. They are found at Madagascar, Ceylon, Swan River, Panama, &c. Manilla is the chief port to which they are taken. There are three principal kinds, which are worth from £2 to £4 per cwt. (1) The silver-lipped, from the Society Islands, of which about twenty tons are annually imported to Liverpool. (2) The black-lipped, from Manilla, of which thirty tons were imported in 1851. (3) A smaller sort, from Panama, 200 tons of which are annually imported; in 1851 a single vessel brought 340 tons (T. C. Archer). These shells afford the "mother-o-pearl" used for ornamental purposes, and the "Oriental" pearls of commerce. Mr. Hope's pearl, said to be the largest known, measure two inches long, four round, and weighs 1,800 grains. Pearl-oysters are found in about twelve fathoms water. The fisheries of the Persian Gulf and Ceylon have been celebrated from the time of Pliny.

MYTILIDÆ.—Here the shell is equivalve, oval or elongated, and closed. The hinge has no teeth. The outer layer is often prismatic, the inner more or less nacreous.

The common Edible Mussel (*Mytilus edulis*) frequents mud-banks which are uncovered at low water; the fry abound in water a few fathoms deep. They are full-grown in a single year. From some unknown cause, they are at times extremely deleterious. The consumption of mussels in Edinburgh and Leith is estimated at 400 bushels (400,000 mussels) each year. Enormous quantities are also used for bait, especially in the deep sea fishery, for which purpose thirty or forty millions are collected yearly in the Firth of Forth alone (Dr. Knapp). Mussels produce small and inferior pearls. At Port Stanley, Falkland Islands, Mr. Macgillivray noticed beds of mussels which were chiefly dead, having been frozen at low water.



THE EDIBLE MUSSEL (*Mytilus edulis*).

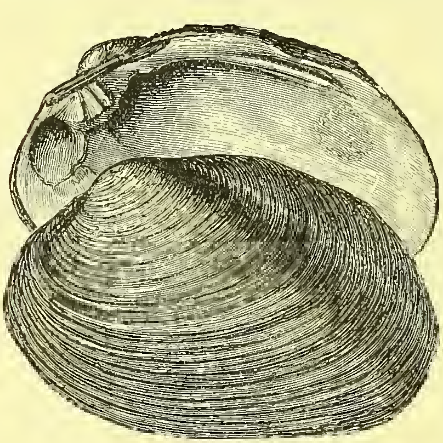
They are largely cultivated on the coasts of France. Quoting from Quatrefages, we read: "Situated on the borders of a kind of mud lake, Esnandes has become the centre of a curious branch of industry, which has spread to the villages of Charron and Marsilly, but which is not to be met with at any other part of the coast. We refer to the breeding of mussels, which is as great a source of general competency to the inhabitants of the Bay of Aiguillon as are the oyster-beds to the fishing population of all our coasts, more especially at Marennes, Cancale, and Saint-Vaast. The origin and development of the mussel trade, which are attested both by tradition and ancient records, have been ably discussed by M. d'Orbigny, in a pamphlet which is very little known, in consequence of its having been published in a small provincial town. It is from this work that we have borrowed the following details:—'In the year 1035, an Irish bark loaded with sheep was thrown in a heavy storm on the rocks near Esnandes, whose sailors, hastening to the scene of the catastrophe, were unable to save any one on board excepting the captain. This man, whose name was Walton, amply repaid the services which had been rendered him; for having saved some of the sheep from the wreck, he crossed them with the animals of the country, and thus produced a fine race, which is still held in high estimation, and is known under the name of the marsh sheep. He next devised a kind of net (the allouret) which was stretched a little above the level of the open sea, where it caught entire flocks of those shore birds which skim the surface of the water at twilight or after dark. In order to render these nets thoroughly effective, it was necessary to go to the very centre of the immense bed of mud, where these birds seek their nourishment, and to secure a sufficient number of poles to support the nets, which were between three and four hundred yards in length. Walton also invented the *pousse-pied*, or *acon*, a kind of boat which is still in use. The acon is composed of a plank of hard wood, which constitutes the bottom, and is called the sole. This plank is bent in the fore part in such a manner as to form a sort of flat prow. Three light planks, which are nailed together at the sides and back, complete this simple boat, which is not more than two or three yards in length, and from twenty to twenty-five inches in breadth. A short pole and a wooden paddle constitute the whole of its equipment. In using the *acon*, the boatman rests on one knee, while he passes the other leg over the side of the boat, where, provided with a long boot, it serves the double purpose of an oar and a rudder. The boatman who is balanced on the sole of the *acon*, whose sides he firmly grasps, plunges his foot into the mud until he reaches a comparatively firmer part, when he propels the boat onward. The *acon* is thus made to glide over the fluid mud; and by means of this fatiguing process the Esnandes boatmen sometimes move with such rapidity, that I have often found it difficult to keep up with them, although I was walking at a quick pace along the beach.

"'The mode of locomotion which we have just described requires a soft and smooth soil. It happens, however, that every year, in consequence of the heavy storms of winter, the bay undergoes a remarkable transformation throughout its whole extent. The mud appears to be moulded by the waves, whose form it retains. From north to south there extend, parallel to the shore, long furrows at equal distances from one another, which are sometimes more than a yard in height. During high tide, the crests of these furrows dry, and harden in the heat of the sun. At such times the *acon* cannot be used; and to enable these boats to be worked easily, it would be necessary to level every part of this vast basin, which extends over a space of more than 75,000,000 of square yards. Such a labour as this, if human industry were to attempt it, would obviously be found to be impracticable, even if the whole population of the district were to devote the entire summer to the task. Yet this herculean labour is accomplished in less than a month through the agency of a crustacean, whose body, which is scarcely thicker than a piece of sewing cotton, is not more than half an inch in length, including the antennæ.

"'Towards the end of April the little crustaceans, termed by the fishermen the *Pernis* (*Corophium longicorne*), arrive from the open sea in myriads. Guided by their instinct, they come to wage an exterminating war against the annelids, which during the whole winter and early spring have multiplied undisturbed. As the tide rises, these voracious hordes are seen moving about in all directions, beating the mud with their long antennæ, and pursuing nereides and the arenicolæ to their deepest recesses. When once they discover one of these animals, which are several hundred times larger than themselves, they combine to attack and devour it, and then resume their eager chase. This carnage never ceases till the annelids have almost entirely disappeared, but by that time the entire bay has been dug up and levelled, and the *acons* are again able to move readily over its surface. Before the close of May the work is completed, and then the Corophium turns up the molluscs and fishes, which it attacks whether living or dead. Through the whole of the summer these crustaceans remain upon the coast, but towards the end of October they all disappear in one night, ready to return the following year and resume their useful labours of digging and delving.

"'Walton discovered, on examining the poles which supported his nets, that they were covered with mussel spawn, and that the molluscs which were thus produced in the open sea, and beyond the immediate contact with the mud, were finer both as to size and quality than those which were bred nearer the shore. He then increased the number of his poles, and after various attempts constructed his first artificial mussel-bed, or *bouchot*. At the level of the lowest tides, he drove into the mud stakes that were strong enough to resist the force of the waves, and placed them in two rows about a yard distant from one another. This double line of poles formed an angle, whose base was directed towards the shore, and whose apex pointed to the open sea. This palisade was roughly fenced in with long branches, and a narrow opening having been left at the extremity of the angle, wicker-work cases were arranged in such a manner as to stop any fishes that were being carried back by the retreating tide. Walton had thus combined in one a sort of fish-preserve with a bed for the breeding of mussels. The merits of this invention must have been at once appreciated, for it soon became very popular, and the *bouchots* were extended in every direction. It was soon found inexpedient to trust only to the chance of the currents and waves that might bring in the young mussels to the poles and fences, and men frequently went to a very great distance, even as far as the *plateau* of Chatelaillon, in search of the young molluscs At the same time this branch of industry was constantly undergoing improvements, becoming as it were more and more systematised, whilst its various operations were designated by names which, having been borrowed from a totally different order of ideas, might lead a stranger, who heard the conversation of two *boucholeurs,* to suppose that they were discoursing on agricultural matters.

" 'The little mussels that appear in the spring are known as the *seeds.* They are scarcely larger than lentils till towards the end of May, but at this time they rapidly increase, and in July they attain the size of a haricot bean. They then take the name of *renouvelains,* and are fit for transplanting. For this purpose they are detached from those *bouchots* which are situated at the lowest tide mark, and are then introduced into pockets or bags made of old nets, which are placed upon the fences that are not quite so far advanced into the sea. The young mussels spread themselves all round the pockets, fixing themselves by means of those filaments which naturalists designate by the name of *byssus.* In proportion as they grow and become crowded together within the pockets, they are cleared out and distributed over other poles lying somewhat nearer to the shore, whilst the full-grown mussels which are fit for sale are planted on the *bouchots* nearest the shore. It is from this part of the mussel-bed that the fishermen reap their harvest, and every day enormous quantities of freshly-gathered mussels are transported in carts, or on the backs of horses, to La Rochelle and other places, from whence they are sent as far as Tours, Limoges, and Bordeaux. They now go to Paris by means of railways, and the epicure may thus compare the wild mussels, which are sent from Normandy and Boulogne, with those that have been artificially bred by Walton's system.



UNIO LITTORALIS.

" 'The following data, which were collected by M. d'Orbigny more than forty years ago, will show how important this branch of industry must be to the district in which it is cultivated. In 1834 the three communes of Esnandes, Charron, and Marsilly, representing a population of 3,000 souls, possessed 340 *bouchots,* the original cost of which was valued by M. d'Orbigny at 696,660 francs. The annual expenses of maintaining them amounted to 386,240 francs, including the interest of the capital employed and the cost of labour, which, however, is spared to the proprietor who works on his own account. The net revenue is estimated at 364 francs for each *bouchot,* or 123,760 francs for the three communes. Finally, the expense of the carts, horses, and boats employed in transporting the mussels then amounted annually to 510,000 francs; but these numbers are far from representing the expenses or profits at the present day. At the time that M. d'Orbigny lived at Esnandes, the *bouchots* were only arranged in four rows; now, however, there are no less than seven rows, and some of them measure more than one thousand yards from the base to the summit. The whole of these *bouchots,* which were at first limited to the immediate neighbourhood of the three villages of which I have already spoken, extend at the present day uninterruptedly from Marsilly far beyond Charron, and form a gigantic stockade of two miles and a half in breadth and six miles in length.' "

TRIGONIADÆ.—This is an interesting family. There are nearly 150 species known in a fossil state, and but three or four known as living. Of these one of the commonest is Trigonia pectinata from Australia. The shell of this species is almost entirely nacreous, and is usually wanting or metamorphic in limestone strata; casts of the interior are called "horse-heads" by the Portland quarry-men; they spoil the stone. Silicified casts have been found at Tisbury, in which the animal itself, with its gills, was preserved. The species with the posterior angle of the shell elongated have a siphonal ridge inside. The epidermal layer of the recent shell consists of nucleated cells, forming a beautiful microscopical object. A Trigonia placed by Mr. S. Stutchbury on the gunwale of his boat leaped overboard, clearing a ledge of four inches. They are supposed to be migratory, as dredging for them is very uncertain, though they abound in some parts of Sydney Harbour.

Unionidæ.—To this family belong a number of fresh-water forms. The river-mussels are found in the ponds and streams of all parts of the world. In Europe the species are few, though specimens are abundant; in North America both species and individuals abound. All the remarkable generic forms are peculiar to South America and Africa. Two of these are fixed and irregular when adult, and have been placed with the chamas and oysters by the admirers of artificial systems; fortunately, however, M. d'Orbigny has ascertained that the genus Mulleria, which is fixed and mono-myary when adult, is locomotive and di-myary when young.

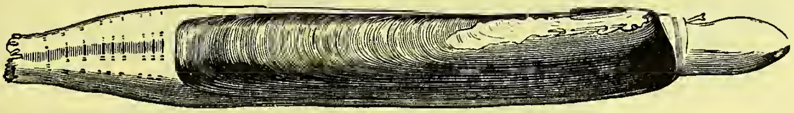
In the Pearl Unio (*A. margaritiferus*) the posterior teeth become obsolete with age. This species, which afforded the once famous British pearls, is found in the mountain streams of Britain, Lapland, and Canada; it is still used for bait in the Aberdeen Cod-fishery. The Scottish pearl fishery continued till the end of the last century, especially in the river Tay, where the unios were collected by the peasantry before harvest time. The pearls where usually found in old and deformed specimens; round pearls, about the size of a pea, perfect in every respect, were worth £3 or £4 (Dr. Knapp). An account of the Irish pearl fishery was given by Sir R. Redding, in the "Philosophical Transactions" for 1693. The shells were found set up in the sand of the river-beds with their open side turned from the torrent. About one in a hundred might contain a pearl, and one pearl in a hundred might be tolerably clear.

Section B.—Siphonida (With Siphons.)

In this section the animal is provided with respiratory siphons, and the mantle-lobes are more or less united.

Cardiadæ.—This family contains the well-known Cockles. The Cockle (*C. edule*) frequents sandy bays, near low water (a small variety lives in the brackish waters of the river Thames, as high as Gravesend). It ranges to the Baltic, and is found in the Black Sea and Caspian. C. rusticum extends from the icy seas to the Mediterranean, Black Sea, Caspian, and Aral. On the coast of Devon the large prickly Cockle (*C. aculeatum*) is eaten. Passing over several representative families, we come to the Solens.

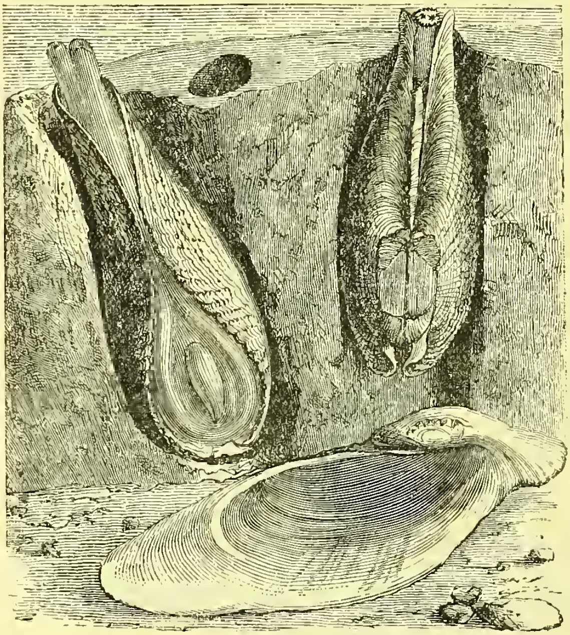
Solenidæ.—This is the family which contains the well-known Razor-fishes. The Razor-fishes (*Solen*) live buried vertically in the sand, at extreme low water, their position being only indicated by an orifice like a key-hole. When the tide goes out they sink deeper, often penetrating to a depth of one or two feet. They never voluntarily leave their burrows, but if taken out soon bury themselves again. They may be caught with a bent wire, and are excellent articles of food when cooked (Forbes). A closely allied genus is that of Solecurtus. The species of this genus bury themselves deeply in sand or mud, usually beyond low water, and are difficult to obtain alive. S. caribæus occurs in countless myriads in the bars of American rivers, and on the coast of New Jersey in sand exposed at low water. By removing three or four inches of sand its burrows may be discovered. They are vertical cylindrical cavities, one inch and a half in diameter, and twelve or more deep. The animal holds fast by the expanded end of its foot.



THE RAZOR-FISH (*Solen vagina*).

Gastrochænidæ.—In this family the shell is equivalve but gaping. The valves are thin, united by a ligament. Sometimes, when adult, they are cemented to a shelly tube. They are burrowers in mud or stone. They are often gregarious, living in myriads near low water line, and are extracted from their abodes with difficulty. One species at least of the genus Gastrochæna (*G. modiolina*) perforates shells and limestone. Its holes are regular, about two inches deep, and half an inch in diameter; the external orifice is hour-glass shaped, and lined with a shelly layer which projects slightly. When burrowing in oyster-shells it often passes quite through into the ground below, and then completes its abode by cementing such loose material as it finds into a flask-shaped case, having its neck fixed in the oyster shell. In some fossil species the siphons were more separated, and the flasks have two diverging necks.

Another genus is called Saxicava, from *saxum*, stone, *cavo*, I excavate, because it excavates its way into stones. Of this genus there is one species (*S. rugosa*) out of which no less than five genera and fifteen species have been manufactured. It is found in crevices of rocks and corals, and amongst the roots of sea-weed, or burrowing in limestone and shells; at Harwich it bores in the cement stone (clay iron-stone), at Folkestone in the Kentish rag, and the Portland stone employed in the Plymouth breakwater has been much wasted by it. Its crypts are sometimes six inches deep (Couch); they are not quite symmetrical, and like those of the Lithodomus, are inclined at various angles, so as to invade one another, the last comers cutting quite through their neighbours; they are usually fixed by the byssus to a small projection from the side of the cell. The Saxicava ranges from low water to 140 fathoms. It is found in the Arctic Seas, where it attains its largest size; also in the Mediterranean, at the Canaries, and the Cape. It occurs fossil in the Miocene tertiary of Europe, and in the United States, and in all the glacial deposits.


PHOLAS DACTYLUS.

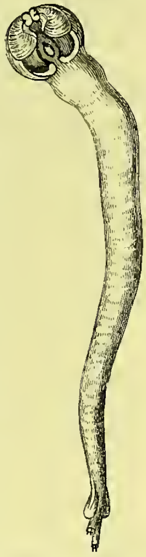
PHOLADIDÆ.—The burrows of the species of this family are vertical, quite symmetrical, and seldom in contact. However tortuous and crowded, they never invade each other, guided either by the sense of hearing or by the yielding of the material, and as the beach wears away the Pholas burrows deeper.

The Common Piddock (*Pholas dactylus*) is used for bait on the Devon coast. Its foot is white and translucent when fresh, like a piece of ice; the hyaline stylet lodged in it is large and curious. P. costata is sold in the market of Havanna, where it is an article of food.

TEREDIDÆ, or Ship-worms, is the last family we can allude to. In these the shell is globular, and the valves three-lobed and striated. The burrow in which they live is partly or entirely lined with a shelly material. The animal is worm-like; the mantle lobes are united and thickened in front, with a minute foot opening; the foot is sucker-like, with a foliaceous border; the viscera are included in the valves, the heart not pierced by the intestine; the mouth is provided with palpi; the gills are long and cord-like, extending into the siphonal tube; the siphons are very long and united nearly to the end. They are attached at the bifurcation and furnished with two shelly pallets or styles; the orifices are fringed. T. navalis is ordinarily a foot long, and sometimes more. It destroys soft wood rapidly, and even teak and oak do not escape. It always bores in the direction of the grain, unless it meets the tube of another Teredo, or a knot in the timber. In 1731-2 it did great damage to the piles in Holland, and caused still more alarm. Metal sheathing and broad-headed iron nails have been found most effectual in protecting piers and ship-timbers. The teredo was first recognised as a bivalve mollusc by Sellius, who wrote an elaborate treatise on the subject in 1733. T. corniformis (Lamarck) is found burrowing in the husks of cocoa-nuts and other woody fruits floating in the tropical seas. Its tubes are extremely crooked and contorted for want of space. The fossil wood or palm fruits (*Nipadites*) of Sheppey and Brabant are mined in the same way. The tube of the Giant Teredo (*Furcella arenaria*) is often a yard long and two inches in its greatest diameter. When broken across it presents a radiating prismatic structure. The siphonal end is divided lengthwise, and sometimes prolonged into two diverging tubes. T. norvegica and T. nana are divided longitudinally and also concamerated by numerous incomplete, transverse partitions at the posterior extremity. One or two species have been described as found in quite fresh water.

The teredo, belongs to the same class as the oyster and mussel, though at first sight there seems to be no resemblance between them. "Imagine to yourself," says Quatrefages, "a kind of worm of a somewhat greyish-white colour, which is sometimes as much as a foot in length, and from six to eight lines in diameter, one extremity of which terminates in a sort of rounded head, whilst the other is like a bifurcated tail. Such is the aspect of a perfectly developed teredo when removed from its tube. The part which I have called the head consists of two small valves, something like two halves of a deeply notched nutshell. These valves are immovable, and only protect a small part of the body properly so-called. The liver and the ovaries lie in contact with one another, very far back and behind the rudimentary shell, whilst the branchiæ are placed in the posterior part of the body. The mantle, forming a sort of fleshy case, envelopes all the viscera, and afterwards divides itself into tubes, which the animal extends or contracts at will. One of these tubes serves to introduce the aerated water, which bathes the branchiæ, and carries to the mouth the organic molecules, which are necessary for the nutrition of the animal; while the other throws off the exhausted water, which collects in its passage the residue of digestion. Thus, in the teredo, the organs, instead of being placed side by side, are arranged behind one another, and this circumstance necessarily induces important modifications in the form, proportions, and general relations of these animals. Nevertheless, although this organisation may appear extremely strange at first sight, it is fundamentally the same as that of all the Acephala, and the philosophical anatomist will have no difficulty in recognising in the ship-worm the essential character of the general type.

"When we examine the delicate and fragile shell, the semi-transparent tissues, and the soft body, which is almost incapable of motion, we can hardly conceive that the teredo is an object to be feared; and yet this mollusc is one of the most formidable enemies of man. The teredo attacks submerged wood somewhat in the same manner as the larvæ of insects, which are vulgarly known as worms, attack wood that has been exposed in the open air. Imagine what would become of our trees and furniture, and of the supports and joists of our roofs, if they were to be gnawed by worms measuring a foot in length. If we supposed this for a moment, we could better understand the damage which these obscure miners perpetrate by their stealthy and silent operations. In a few months, or even a few weeks, thick planks or piles of the strongest oak or pine, which to all appearance are perfectly sound, are sometimes found to be so completely excavated that, unable to offer further resistance, they yield to the slightest shock. Thus large openings have suddenly been made in ships at sea beneath the feet of the sailors, utterly unsuspicious of the danger to which they were exposed; and at the beginning of the last century one-half of Holland was nearly engulfed in the waves, in consequence of the piles which supported her large dykes having all been destroyed and undermined by the teredos."



TEREDO NAVALIS.

Only one method has hitherto been proposed as a prevention against the recurrence of similar disasters, and this is by investing all submarine wooden structures with a complete metallic casing. The object of coppering the bottom of ships is chiefly with the view of protecting them against the attacks of the teredo. Unfortunately, however, this method is inapplicable for structures of submerged wood, which every year pay a very considerable tribute to these destructive molluscs. In our own day, however, science places at the disposal of industry many valuable resources which were unknown to our forefathers, and I believe it will be found very easy to destroy the teredo within a given space, and consequently to protect our wharves and other wooden structures from the attacks of these animals.

CLASS V.—BRACHIOPODA.

The Brachiopoda are bivalve shell-fish which differ from the ordinary mussels, cockles, &c., in being always equal-sided, and never quite equivalve. Their forms are symmetrical, and so commonly resemble antique lamps that they were called lampades, or "lamp-shells," by the old naturalists (Meuschen, 1787; Humphreys, 1797); the hole which in a lamp admits the wick serves in the lamp-shell for the passage of the pedicle by which it is attached to submarine objects.

The valves of the Brachiopoda are respectively dorsal and ventral; the ventral valve is usually largest, and has a prominent beak, by which it is attached, or through which the organ of adhesion passes. It is sometimes perforated, as in the Terebratulidæ. The dorsal, or smaller valve, is always free and imperforate. The valves are articulated by two curved teeth, developed from the margin of the ventral valve, and received by sockets in the other. This hinge is so complete that the valves cannot be separated without injury. A few genera have no hinge; in Crania and Discina the lower valve is flat, the upper like a limpet; the valves of Lingula are nearly equal, and have been compared to a duck's bill (Petiver). The articulated group sometimes possess an anal aperture; the unarticulated none (Hancock).

The valves are both opened and closed by muscles; those which open the shell (*cardinales*) originate on each side the centre of the ventral valve, and converge towards the hinge-margin of the free valve, behind the dental sockets, where there is usually a prominent cardinal process. The teeth form the fulcrum on which the dorsal valve turns.

On separating the valves of a recent Terebratula, the digestive organs and muscles are seen to occupy only a very small space near the beak of the shell, partitioned off from the general cavity by a strong membrane, in the centre of which is the animal's mouth.

The mouth conducts by a narrow œsophagus to a simple stomach, which is surrounded by the large and granulated liver; the intestine of Lingula is reflected dorsally, slightly convoluted, and terminates between the mantle lobes on the right side. In Orbicula it is reflected ventrally, and passes straight to the right, ending as in Lingula. In Terebratula, Rhynchonella, and probably all the articulated Brachiopoda, the intestine is simple and reflected ventrally, passing through a notch or foramen in the hinge-plate, and ending behind the ventral insertion of the adductor muscle.

The circulatory system is far less complex than was formerly supposed, and does not differ greatly from the same system in the Tunicata. The heart is placed on the dorsal surface of the stomach, and consists of a simple, unilocular, pyriform vesicle, without any auricle. From it the blood is propelled through four channels to the organs of reproduction and to the mantle; and its flow is probably assisted by a number of subsidiary pulsatile vesicles situated on the main arterial trunks. It then courses through the plexus of lacunes in the pallial sinuses and lobes; turns back through the lacunes of the parietes into the system of visceral lacunes. It probably enters the liver, and ultimately finds its way back into the heart through the branchio-systemic vein. There is, however, another and more important blood current, which traverses the whole length of the brachial canal, and penetrates to the extremities of the cirri, before it joins the current returning from the visceral lacunes and flows with it into the branchio-systemic vein. The blood which has passed through the brachial canal is far more highly oxygenated than the blood which has flowed through the pallial membranes. There seems to be some evidence that the so-called arms are really the gills or respiratory organs of the mollusc. They also serve to bring food to the creature's mouth by the means before noticed. The mantle is an accessory breathing-organ. It attains its highest development as such in Lingula, but even in this genus the brachial apparatus performs the chief part in oxygenating the blood.

The Lamp-shells are all natives of the sea. They are found hanging from the branches of corals, the under sides of shelving rocks, and the cavities of other shells. Specimens obtained from rocky situations are frequently distorted, and those from stony and gravelly beds, where there is motion in the waters, have the beak worn, the foramen large, and the ornamental sculpturing of the valves less sharply finished. On clay beds, as in the deep clay strata, they are seldom found; but where the bottom consists of calcareous mud they appear to be very abundant, moving themselves to every hard substance on the sea-bed, and clustering one upon the other.

Of all mollusca the Brachiopoda enjoy the greatest range both of climate, and depth, and time. They are found in tropical and polar seas, in pools left by the ebbing tide, and almost at the greatest depths explored by the dredge. At present only eighty-four recent species are known; but more will probably be described from the deep sea researches of the *Challenger*. The number of living species is already greater than has been discovered in any secondary stratum, but the vast abundance of fossil specimens has made them seem more important than the living types, which are still rare in the cabinets of collectors, though far from being so as individuals in the sea. Above 1,000 extinct species of Brachiopoda have been described, of which more than half are found in England. They are distributed throughout all the sedimentary rocks of marine origin, from the Cambrian strata upwards, and appear to have attained their maximum of specific development in the Silurian age.

Of the eight families into which Mr. Davidson divides this class three are known only by fossil species. These are the families SPIRIFERIDÆ, ORTHIDÆ, PRODUCTIDÆ. Of the total number of Brachiopods described, about 800 species belong to these families. Of the families with living representatives we have the following :—

TEREBRATULIDÆ.—There are about sixty species belonging to this family described as living, and upwards of 300 known as fossil. The living forms are chiefly found in deep water in the Atlantic, and off the coasts of Australia. Species of Terebratella are found from Spitzbergen to Cape Horn, and Valparaiso to New Zealand. Terebratula caput serpentis, with a few other species, are found off our own coasts in deep water.

RHYNCHONELLIDÆ.—Nearly 400 species belonging to the genera Rhynchonella, Pentamerus, and Atrypa are known as fossil, while only some half-dozen species belonging to the first genus are known in a living state. R. psittacea is found off Labrador.

CRANIADÆ.—This family contains but a single genus, Crania. Some five or six species are still met with living. One is a native of the British Coasts (*C. anomala*), but some forty species are described as fossil, chiefly occurring in the Lower Silurian.

DISCINIDÆ.—In this family the shell is attached by a stalk, which passes through an opening in the ventral valve, and the valves are not articulated. The shell in the genus Discina is orbicular and horny. Some twelve species have been described from the deep seas in the neighbourhood of Peru and Panama, off the west coast of Africa and the Malacca. Over seventy-five species are described as fossil.

LINGULIDÆ.—In this very remarkable family the shell is oblong. The valves are not alike. A stalk, by means of which the animal is attached, passes out between the valves; the texture of these is horny. Lingula anatina is the best known species. It is found on the coasts of the Pacific.

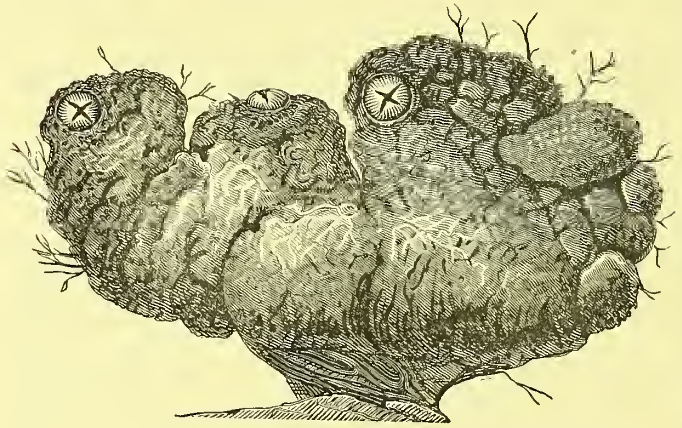
CLASS VI.—TUNICATA.

UP to quite recently the species of this class have been placed among the Mollusca, forming, with the Polyzoa, a sub-group called Molluscoidea. This is scarcely the place to enter on any controversial subject, but in placing them where we do we depart from the arrangement approved of by Gegenbaur and Haeckel, and we follow that by Milne-Edwards, Huxley, Lankester, and others. The Tunicates form a large class of marine animals, living either singly or in colonies, sometimes free swimming, and at other times attached. Before reaching their adult state probably all pass through some change of form. They vary in size, from creatures scarcely visible to masses of four feet and upwards in length. Some of them are highly phosphorescent, and go rolling through the tropical seas like lumps of molten metal. Their respiration is branchial. Their blood is colourless, or nearly so; and the heart exhibits a phenomenon unique, we believe, in the animal kingdom. The blood is sent first in one direction, then the heart stops for a brief moment, and then goes on, sending the blood in the opposite direction. More than 300 species are known.

To the free-swimming forms belong the curious Oceanic Salpæ. These animals about a century ago were entirely unknown. Sometimes they are to be met with in incredible quantities. The first announcement of them was made by P. Brown, in his Civil and Natural History of Jamaica, published in 1756, under the name of "Itralia." Afterwards followed the description of the species observed in the Mediterranean and Red Sea, under that of Salpa, by the Danish traveller Forskal.

These animals, according to the testimony of Péron, Tilesius, Meyen, and others, are usually phosphorescent by night. The Salpæ are met with at one time singly, as distinct individuals, at another united either in rings or in long chains, of which the arrangement is various, yet similar in individuals of one and the same species. These are attached to each other by tubercles or prolongations. Chamisso, from his observations on living animals, arrived at the conclusion that successively a generation of distinct Salpæ alternates with that of Salpæ connected, and forming a chain. Thus a metamorphosis occurs, which, however, does not take place in the same individual, but in two succeeding generations. The parent animal, for instance, always resembles her grand-daughter and her sister, not her daughter, which, again, resembles the preceding generation. This conclusion seemed to most succeeding observers so strange, that they thought it could not be adopted. Meyen supposed that these animals are always born as single individuals, and only became united subsequently. Nevertheless, Eschricht discovered within single individuals embryos connected together in a wreath, so that hereby Chamisso's conclusion was established, that chains of connected Salpæ were formed even within the parent. Steenstrup brought this peculiarity in the propagation of the Salpæ into unison with other phenomena in the animal kingdom.

The genus Pyrosoma, of compound Ascidiæ, was first discovered by Péron and his fellow-voyagers in the Atlantic Ocean under the tropics, when on a dark night numerous specimens of it appeared to form a broad band of light across the sea. From this phosphoric quality the name (Fire-body) is derived. At first these compound animals were supposed to be a single animal, and the single individuals of which a Pyrosoma is compounded, to be little tubercles on the surface of the animal. To the affixed forms belong both the simple and compound Ascidiæ. Of the latter we have the lovely star-like masses so often found encrusting the fronds of sea-weeds belonging to the genera Botryllus, Didemnum, &c.; to the former, the solitary forms like the species of the genus Ascidia. These are always attached to other bodies, to rocks, shells, crabs, &c. Often several individuals are united in a single group (*Cynthia*). They never, however, form such a compound body as the preceding genera. These animals take in water through the branchial aperture, and eject it chiefly by the same aperture in jets, which may serve as a defensive means for chasing animals away that attack them.



CYNTHIA MICROCOSMUS (SAVIGNY).

Ascidians live on small organic particles, which are brought with the water into the respiratory sac, and thence to the œsophagus that opens at its bottom. Sometimes, indeed, small crustaceans have been found in the sac, but they would often seem to have arrived there fortuitously, for when they have been taken in by an Ascidian they are rather hurtful than beneficial, and in some cases even injure the tissue of the gills.

SUB-KINGDOM IV.—ECHINODERMATA.

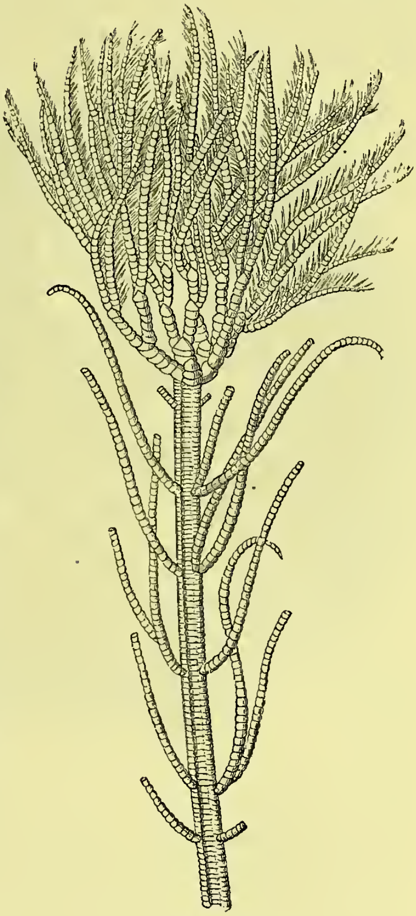
This sub-kingdom contains a considerable number of marine animals, some of which, under the names of star-fish, sea-urchins, and sea-lilies, are known to most people. Some of the sea-lilies have been long and well known in a fossil state as stone-lilies; and, indeed, there are even now more species of this sub-kingdom known from their fossil than from their recent remains.

The integument is mostly leathery (coriaceous), often with chalky particles, in the shape of plate or spicules, embedded in it. Sometimes, as in Echinus, this will bear a formidable array of spines. All the other important systems are more or less developed in the members of this sub-kingdom. The alimentary system is separated from the general body cavity of the animal, often hanging freely in it. The digestive cavity is furnished with very minute eyelash-like bodies (cilia). In some it runs straight through the body, in others it is more tortuous. The sea water is found to penetrate into the cavity of their bodies, and is in connection with a wonderful series of water-holding canals, which are in communication with small hollow muscular processes, which are capable of being projected, and by means of which these Echinoderms, when locomotive, generally progress. This, called the ambulacral system of vessels, is almost peculiar to the sub-kingdom.

A good deal has yet to be known as to the development of the Echinoderms; but, thanks to the researches of many recent zoologists, a good deal is known. From the egg, a simple, free-swimming form, covered over with cilia, called the pluteus, arises, and from this the future adult form springs, the whole of the pluteus form not passing over, as it were, into the new creature. The sexes are generally distinct. Some most strange forms, apparently truly viviparous, have been described by Sir Wyville Thomson. These were found off the Falklands and at Kerguelen's Land. This sub-kingdom is easily divided into the following five orders, so far as the living forms are concerned.

ORDER I.—CRINOIDEA.

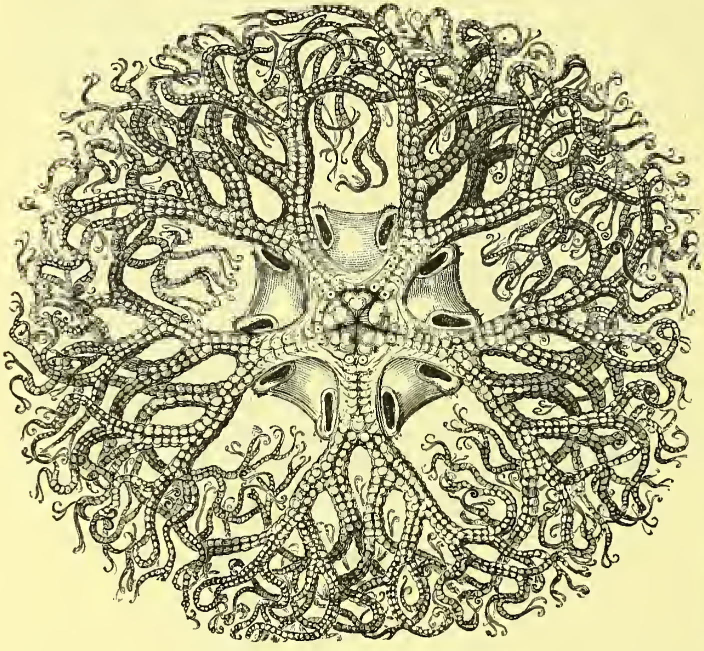
The order of the Crinoidea contains the lily stars. They are mostly stalked, though in a few cases the star-like form, when it becomes adult, drops off from its stalk and swims about. The arms can move with rapidity, and taking up food convey it to the mouth, which they can also protect. For a long time only one recent stalked form was known. This species (*Pentacrinus caputmedusæ*) was a native of the Caribbean Seas; and the number of specimens existing in the European museums about twenty years ago did not exceed ten in number. Nowadays zoologists are waiting for Sir Wyville Thomson's account of the many new strange and lovely species found by him in the expedition of the *Porcupine* and the cruise around the world in the *Challenger*, and we know that he will describe among them several new genera and a great many new species. One species is not uncommon around our own shores. It is stalked when young, but free-swimming when old. It (*Comatula rosacea*) is a very lovely form, and for a knowledge of its life history we are indebted first to J. Vaughan Thompson, and secondly to Sir C. Wyville Thomson and Dr. Carpenter.



PENTACRINUS ASTERIAS (L.).

ORDER II.—OPHIUROIDEA.

The second order (Ophiuroidea) contains the brittle stars. They have rounded or angular disc-shaped bodies, with five often very long snake-like arms. They are never pedunculate or stalked. In one fine tropical species (*Ophiura longipeda*) the arms are more than twenty times the diameter of the disc of the body. In our own native brittle sand stars the difference is never so great. One very remarkable species is known as the Medusa's Head. It is one of the most singular and beautiful forms belonging to this order. Agassiz tells us that a singular species of Ophiuran, known among fishermen as the "basket-fish" (*Astrophyton agassizii*), is to be found in Massachusetts Bay. Its arms are very long in comparison to the size of the disc, and divide into a vast number of branches. In moving, the animal lifts itself on the extreme end of these branches, standing as it were on tip-toe, so that the ramifications of the arms form a kind of trellis-work all around it, reaching to the ground, while the disc forms a roof. In this living house with latticed walls, small fishes and other animals are occasionally seen to take shelter; but woe to the little shrimp or fish who seeks a refuge there. If he be of such a size as to offer his host a tempting mouthful, he will fare as did the fly who accepted the invitation of the spider. These animals are very voracious, and sometimes, in their greediness for food, entangle themselves in fishing lines or nets. When disturbed they coil their arms closely around the mouth, assuming, at such times, a kind of basket-shape, from which they derive their name.


ASTROPHYTON AGASSIZII.

This basket-fish is honourably connected with our early colonial history, being thought worthy, by no less a personage than John Winthrop, Governor of Connecticut, who, as he says, "had never seen the like," to be sent with "other natural curiosities of these parts," to the Royal Society of London, in 1670. He accompanies the specimen with a minute description, omitting "other particulars, that we may reflect a little upon this elaborate piece of nature." His account is as graphic as it is accurate, and we can hardly give a better idea of the animal than by extracting some portions of it. "This fish," he says, "spreads itself from a pentagonal root, which encompasseth the mouth (being in the middle), into five main limbs or branches, each of which, just at issuing out of the body, subdivides itself into two, and each of these ten branches do again divide into two parts, making twenty lesser branches; each of which again divide into two smaller branches, making in all forty. These again into 80, and these into 160; and these into 320; these into 640; into 1,280; into 2,560; into 5,120; into 10,240; into 20,480; into 40,960; into 81,920; beyond which the further expanding of the fish could not be certainly traced;" a statement which we readily believe, wondering only at the patience which followed this labyrinth so far.

In a later letter, after having had an interview with the fisherman who caught the specimen, and, as he says, "asked all the questions I could think needful concerning it," the Governor proceeds to tell us that it was caught "not far from the shoals of Nantucket" (which is an island upon the coast of New England), and that when "first pulled out of the water it was like a basket, and had gathered itself round like a wicker-basket, having taken fast hold upon that bait on the hook which he" (the fisherman) "had sunk down to the bottom to catch other fish, and having held that within the surrounding brachia, would not let it go, though drawn up into the vessel, until, by lying a while on the deck, it felt the want of its natural element, and then voluntarily it extended itself into the flat round form, in which it appeared when presented to your view." The Governor goes on to reflect in a philosophical vein upon the purpose involved in all this complicated machinery. "The only use," he says, "that could be discerned of all that curious composure wherewith nature had adorned it, seems to be to make it as a purse-net to catch some other fish, or any other thing fit for its food, and as a basket of store to keep some of it for future supply, or as a receptacle to preserve and defend the young ones of the same kind from fish or prey, if not to feed on them also (which appears probable, the one or the other), for that sometimes there were found pieces of mackerel within that concave. And he, the fisherman, told me that once he caught one which had within the hollow of its embracements a very small fish, which was judged to be a mackerel. And that small one ('tis like) was kept either for its preservation or for food to the greater; but, being alive, it seems most likely it was there lodged for safety, except it were accidentally drawn within the net, together with that piece of fish upon which it might be then feeding." The account concludes by saying, "The fisherman could not tell me of any name it hath, and 'tis, in all likelihood, yet nameless, being not commonly known as other fish are. But until a fitter *English* name be found for it, why may it not be called (in regard of what hath been before mentioned of it) a *basket-fish*, or a *net-fish*, or a *purse-net-fish?*" And so it remains to this day, as the Governor of Connecticut first christened it, the basket-fish.

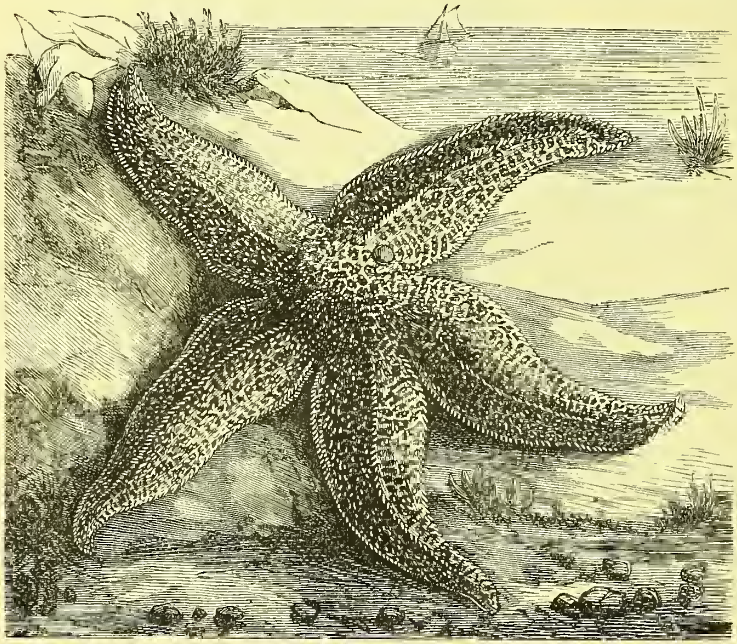
ORDER III.—ASTEROIDEA.

The common Star-fishes will be characteristic examples of this order. The arms seem to be only prolongations of the body, and are five in number. Their form is very various, as in Luidia they seem to be all arms, while in Solaster the body is large, and the little processes that serve as arms are twelve to fourteen in number. They do not swim, but creep about by means of their ambulacral feet, with their mouth downwards. They feed principally upon molluscs.

The following account, by Professor Edward Forbes, of an attempt to capture a Luidia, gives a good illustration of its powers:—"The first time that I took one of these creatures," the Professor says, "I succeeded in placing it entire in my boat. Not having seen one before, and being ignorant of its suicidal powers, I spread it out on a rowing bench, the better to admire its form and colours. On attempting to remove it for preservation, to my horror and disappointment I found only an assemblage of detached members. My conservative endeavours were all neutralised by its destructive exertions; and the animal is now badly represented in my cabinet by a discless arm and an armless disc. Next time I went to dredge at the same spot I determined not to be cheated out of my specimen a second time. I carried with me a bucket of fresh water, for which the star-fishes evince a great antipathy. As I hoped, a Luidia soon came up in the dredge—a most gorgeous specimen. As the animal does not generally break up until it is raised to the surface of the sea, I carefully and anxiously plunged my bucket to a level with the dredge's mouth, and softly introduced the Luidia into the fresh water. Whether the cold was too much for it, or the sight of the bucket was too terrific, I do not know; but in a moment it began to dissolve its corporation, and I saw its limbs escaping through every mesh of the dredge. In my despair I seized the largest piece, and brought up the extremity of an arm with its terminal eye, the spinous eyelid of which opened and closed with something exceedingly like a wink of derision."

The common Cross-fish (*Uraster rubens*) is the commonest species, while one of the most beautiful and rarest is, perhaps, the lovely Brisinga coronata of the Norwegian coast.

Nearly a quarter of a century ago the celebrated poet and naturalist, P. Chr. Asbjörnsen, was dredging in the interior of the picturesque Hardangerfjord, when, at a depth of about 200 fathoms, the dredge brought up a wonderful new star-like Echinoderm, quite unlike any form that had been, up to that moment, described. From a little circular disc, of about an inch in diameter, there issued eleven spreading arms or rays, upwards of a foot each in length. These were armed along the edges with several rows of long spines. These arms, while standing near together at their base, generally taper away gradually to their tips. The colour, though variable, was, on the upper or dorsal surface, of a more or less red hue, and paler, often to whiteness, on the under surface. On the lower surface of the disc, and occupying the central space, is seen the mouth-like aperture of the alimentary system, and spreading away from it along the centre of each ray-like arm are the deep ambulacral furrows, so called because from these furrows issue the ambulacra, or water-feet. These form two uninterrupted rows, and are flanked by several palisades of strongly-developed spines, the outer ones being the longest. All these spines are enveloped in an integument which is covered with strange-looking pedicellariæ.



ASTERIAS RUBENS.

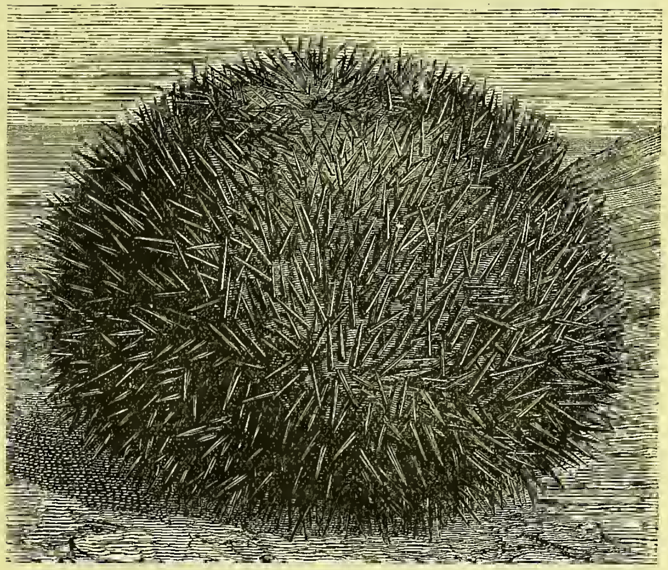
Only an instant's glance at this brilliant novelty was vouchsafed to the poet-naturalist, for beneath his glance the star-fish, thus brought up to quarters new to it, threw off all its arms, and what was once a thing of beauty became now a tangled mass of writhing arms moving away from the disc that had such a long time borne them company.

From living in great darkness and in the tranquil depths of the ocean's bosom, the being brought so suddenly up into the bright sunlight, and to the agitated movements of that ocean's surface, was too great a change and too severe a shock, and the catastrophe just mentioned was the consequence. To Asbjörnsen, however, this thing of beauty seemed like a link in the chain of the past. In its unlikeness to most recent forms of star-fishes he saw its connection with certain fossil forms, and in its brilliant sun-like form he was reminded of the "Brising" which, according to ancient Norwegian tradition, was concealed by Luke in the abyss of the primæval ocean, but which had so long served as the ornament to cover the breast of the god Frega, and he gave the name of Brisinga to the new genus.

From the number of its arms Asbjörnsen called this new species B. endecacnemos, and until quite recently it was the only species known. In one locality of the Fjord-Hesthammer its occurrence cannot be considered as very rare. It has also been dredged by Professor G. O. Sars some miles north of Bergen; by Sir Charles Wyville Thomson, in the North Atlantic; and off the west coast of Portugal by Mr. Gywn Jeffreys. A second species of this genus was, in 1869 and 1874, brought up by Professor G. O. Sars, at the fishing-place, Skraaven, in Lofoten, from a depth of 300 fathoms, and it has been made the subject of an elaborate memoir, in which the structure and affinity of the genus is fully discussed. With the aid of a tolerably large number of fresh specimens, and by repeated careful dissections, Sars has been enabled to ascertain most of the points in connection with its histology. He considers the functions of the remarkable little organs, called Pedicellariæ, which occur in most surprising number in both species of Brisinga, as that of seizing and holding fast the objects which come in contact with them; those that are found on the dorsal surface thus acting as protectors to the thin skin, and those on the lower surface acting in the service of alimentation.

Among living star-fishes, Brisinga seems to stand isolated, coming perhaps nearer to Pedicellastes; with the oldest known fossil star-fish, Pristastes, it shows less affinities, but would seem to be older and less specialised; and if so it would then be the most primitive as well as oldest form known of star-fishes. It must, therefore, be kept in a family of Echinoderms by itself, which may be called Brisingidæ.

ORDER IV.—ECHINOIDEA.


ECHINUS ESCULENTUS.

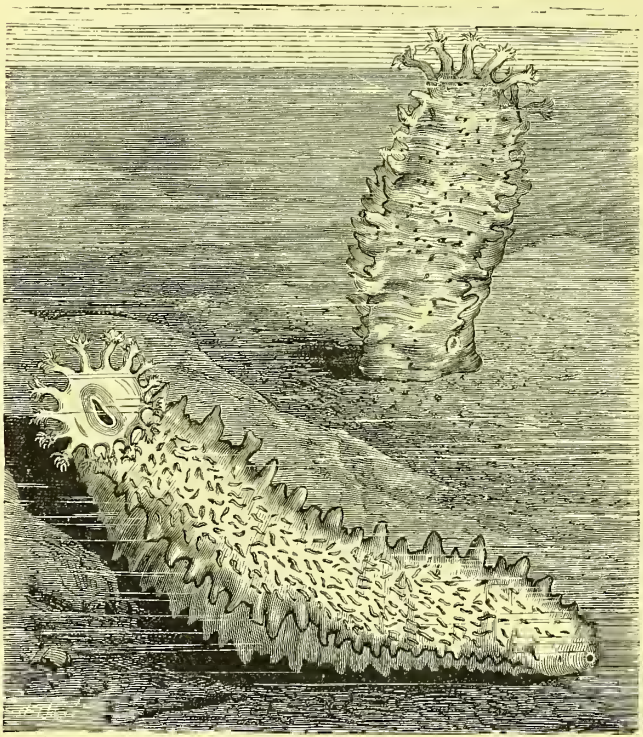
In this order the species are covered with, in general, a calcareous shell, made up of many series of pentangular or hexangular-shaped plates. They are arranged in ten rows, five of which are narrower than the others, and all are perforated so as to allow of the ambulacral feet to be obtruded. By means of these locomotion is effected. The growth of the shell takes place by the enlargement of these plates and by the addition of new ones. The spines are attached to little tubercles on the surface of the shell. The mouth is provided with fine teeth with sharp, hard points, and the whole mouth structure is very complicated; to it, with the array of muscles which move the teeth, the curious name of Aristotle's Lantern is given. The shape of the calcareous body varies in this order very much. It is called the corona, and is sometimes flat, sometimes nearly globular, and very commonly only partly globose (sub-globose). These sea-urchins cannot swim, but they can creep along the bottom of the sea. Some of them can excavate cavities in the soft limestone of the sea-coast, and live in these cavities. They are vegetable feeders, and are themselves eaten by man, at least in the Mediterranean. A number of wonderful forms have been found in the famous expedition of the *Challenger* around the world. Vast numbers, too, are found in a fossil condition. About 220 species are known as living at the present day. The common Sea-urchin (*Echinus esculentus*) is usually of a reddish or purplish colour, with white spines. The spines are, in some specimens, tipped with purple. It lives in various depths of water, extending its range from the littoral zone to that of corallines. It usually congregates in greatest numbers on a clean sea bottom. It is found on all the shores of Britain and Ireland, almost equally everywhere, and is much used as a chimney ornament by cottagers. Abroad it is much eaten, and Pennant says it is eaten by the poor in many parts of England. Among the ancients it was a favourite dish, and eaten both raw and cooked in various ways. The ovaries were the parts selected, and when these are full of eggs the animal is in season, which is usually about autumn.

The Purple-egg Urchin (*Strongylocentrotus lividus*) was first observed as British by Dr. Leach, who, supposing it to be altogether undescribed, exhibited it to the Wernerian Society under the name of Echinus lithophagus. In many places where it is found it is seen inhabiting cavities or depressions in rocks, corresponding to it in size, and evidently formed by itself. Mr. Bennett describes each cavity as circular, agreeing in form with the contained urchin, and so deep as to embrace more than two-thirds of the bulk of the animal inhabitant. They are large enough to admit of the animal rising in them a little, but not of its coming out easily, and their depth is in several considerably increased by the deposition around their upper circumference of a species of Nullipore several lines in thickness, and by a thin layer of which they are lined throughout. The urchins adhere, by their numerous suckers, so firmly to the lodgment they have formed, as to be forced with extreme difficulty from them when alive.

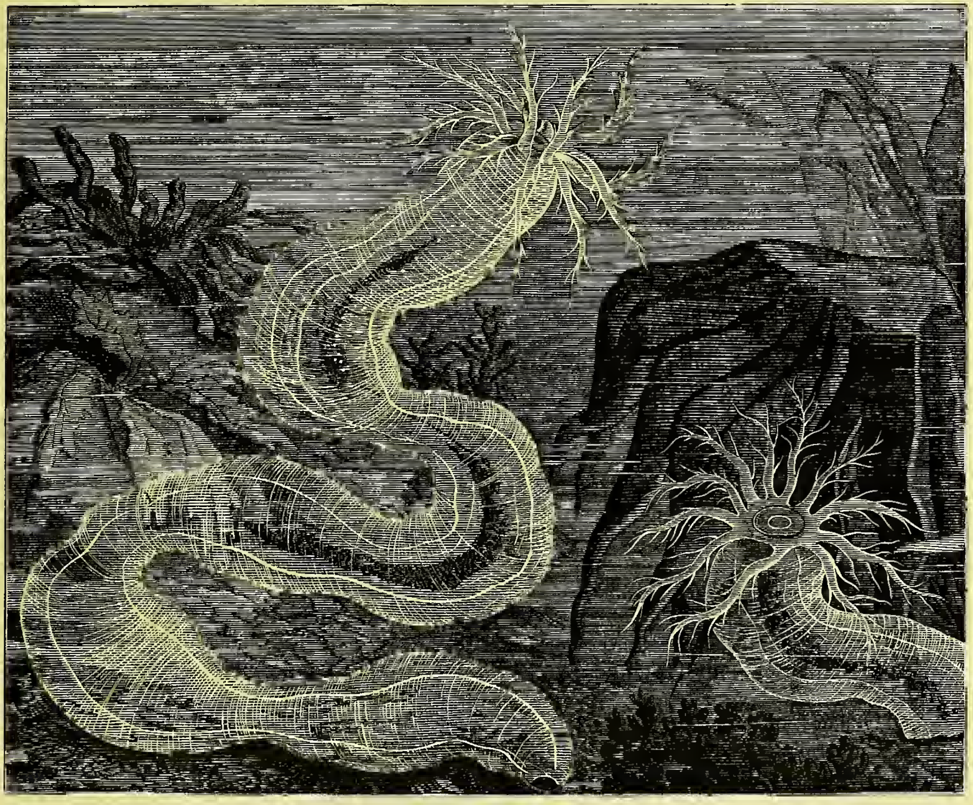
In the British Isles this species is peculiar to Ireland, where it is chiefly found in the south, but it ranges as far as Bundoran, where it was noticed by Mr. Hyndman. Dr. Ball, who paid particular attention to this species, describes no less than five varieties.

ORDER V.—HOLOTHUROIDEA.

The body in the Sea Cucumbers is mostly cylindrical, and covered with a coriaceous skin, in which are numerous calcareous particles very variously shaped. The mouth is surrounded by a mass of tentacles, or feelers, that are easily drawn in (retractile). These are often beautifully branched, and are mostly ten or twenty in number. In some the little calcareous bodies in the skin are anchor shaped, and can be felt if the skin is gently drawn between the fingers. Some of the very smallest of the Echinoderms are found in this order, but it possesses some species that grow to a length of five to six feet, and such, when seen gliding along the surface of some white coral rock, look like marine snakes. So far as we know but one species is used for food. This, the Trepang of the Chinese (*Holothuria edulis*), is found in the Indian Ocean. Thousands of junks are annually equipped for the trepang fisheries. The Malay fishermen carry to this fishery a degree of patience and dexterity truly remarkable. Lying down in the forepart of their vessels, and holding in their hands a long bamboo terminating in a sharp hook, their eyes, accustomed to this fishing, frequently discover the animal at a distance of not less than thirty yards, as it creeps along the surface of the submarine rocks or corals. The fisher darts his harpoon at this distance, and seldom misses his prey. When the water is shallow, that is to say not more than four or five fathoms deep, divers are sent down to obtain these coveted morsels, who seize them in their hands, and in this manner can take five or six at a time. To prepare the fish and preserve them for transport to the markets, the Malay and Chinese fishermen boil them in water and flatten them with stones. They are then spread out on bamboo mats to dry; first in the sun, and then by smoking them. Thus prepared, they are enclosed in sacks and shipped to the Chinese ports, where they are particularly esteemed. This fishery takes place in the months of April and May.


HOLOTHURIA LUTEA.

A species of Synapta, known as Synapta duvernea, is represented in the figure. M. Quatrefages, who discovered it in the English Channel, gives the following description of it in his work, "Les Souvenirs d'un Naturaliste." "Imagine," he says, "a cylinder of rose-coloured crystal, as much as eighteen inches long, and more than an inch in diameter, traversed in all its length by five narrow ribbons of white silk, and its head surmounted by a living flower, whose twelve tentacles of purest white fall behind in a graceful curve. In the centre of these tissues—which rival in their delicacy the most refined products of the loom—imagine an intestine of the thinnest gauze, gorged from one end to the other with coarse grains of granite, the rugged points and sharp edges of which are perfectly perceptible to the naked eye.



SYNAPTA DUVERNEA.

"But what most struck me at first in this animal was, that it seemed literally to have no other nourishment than the coarse sand by which it was surrounded. And then, when, armed with scalpel and microscope, I ascertained something of its organisation, what unheard of marvels were revealed! In this body, the walls of which scarcely reach the sixteenth part of an inch in thickness, I could distinguish seven distinct layers of tissue, with a skin, muscles, and membranes. Upon the petaloid tentacles I could trace terminal suckers, which enabled the Synapta to crawl up the side of a most highly-polished vase. In short, this creature, denuded to all appearance of every means of attack or defence, showed itself to be protected by a species of mosaic, formed of small calcareous, shield-like defences, bristling with double hooks, the points of which, dentated like the arrows of the Caribbeans, had taken hold of my hands. If one of these Synapta is preserved alive in sea-water for a short time, and subjected to a forced fast, a very strange phenomenon will be observed. The animal, being unable to feed itself, successively detaches various parts of its own body, which it amputates spontaneously."

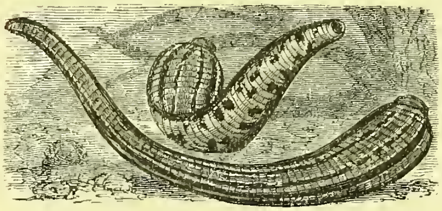
SUB-KINGDOM V.—VERMES.

This sub-kingdom contains a number of species more widely differing in external appearance from each other than any of the others. Here we find placed, not only the land worms, but the leeches, the brilliantly-coloured marine worms, and the often plant-like Polyzoa. They are all bilaterally symmetrical forms, generally soft-bodied, never having jointed limbs. It is difficult to know whether some of the forms included here might not better be placed with the Mollusca; but Haeckel's classification is here in part adopted. This divides the sub-kingdom into two divisions. In the first (Cœlomati) the animals have a specialised blood system whereas in the second (Acœlomati), this blood system is not to be found. Of the seven classes into which it is convenient to again sub-divide these two divisions we must say a word or two about each.

CLASS I.—ANNELIDA.

This class contains a number of species, of which the common leech, the earth-worm, and the lug-bait will serve as types; indeed, there are three orders, into each of which one of the just-mentioned forms would go.

ORDER I.—THE HIRUDINEA.


THE MEDICINAL LEECH (*Hirudo medicinalis*).

The species of this order have ringed bodies, slimy, with a prehensile cavity at both ends of their body. At the mouth end is a suctorial disc. They creep along the ground by alternately contracting and extending their bodies. They can swim with a sinuous motion. The Medicinal Leech (*Hirudo medicinalis*) is the most useful species, which almost everywhere in Europe lives in fresh water, especially in ponds, marshes, and canals, and in winter, rolled up in a ring, conceals itself in the mud. This animal lives on the blood of animals (vertebrate and invertebrate) exclusively. The jaws serve to wound and to penetrate the skin. The first segment of the body, which also is occasionally parted by a transverse stripe, has a semilunar form, and is not closed beneath. It can extend itself as an upper lip for feeling, or bend itself downwards to cover the mouth. Ten black eye-spots are arranged in the form of a horseshoe on the back side of the head, the first pair on the first segment, the two next on the third, and the two last on the sixth ring, of the body. Most of the species known are fresh-water, but some (Pontobdella) are parasites on marine fish.

ORDER II.—THE OLIGOCHÆTA.

The species here differ from those in the previous order, by having the rings of the body more or less furnished with delicate bristles (setæ), by which they are enabled to progress. These may be felt if one draws gently an earth-worm through one's fingers, from the tail to the head. In the Earth Worm (*Lumbricus terrestris*) the bristles are not retractile; they are short and rigid, in every ring eight, that is, two pairs on either side. Externally it presents a body composed of numerous narrow rings closely approximated to each other. At about one-third of their length may be seen, particularly at the season of reproduction, the clitellum, which becomes at that time a highly important organ. The colour of the body is reddish or bluish, and of a shining aspect, and the animal has the power of secreting a viscous substance which forms a sort of protecting sheath to its body, and greatly facilitates its progress through the earth. The animal is eyeless, and unprovided with either tentacles, branchiæ, or cirrhi.

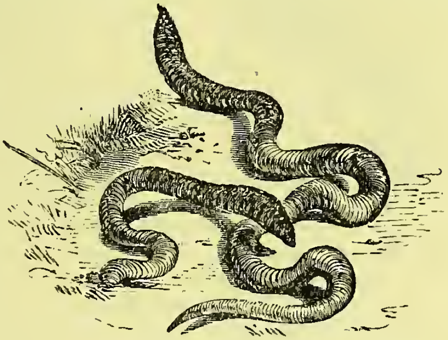
The mouth consists of two lips without tentacles or armature of any description; but the upper lip is elongated and proboscidiform. The œsophagus, which is a wide membranous canal, is continued straight down for half an inch, and ends in a dilated bag or reservoir, to which succeeds a muscular stomach or gizzard, disposed in the form of a ring

The intestine is constricted at each segment of the animal by a series of ligaments or partitions, connecting it to the parietes of the body, and swells out the intermediate spaces when distended by the particles of earth.

The nervous system of the earth-worm consists of a double row of small ganglions close to each other. Earth-worms creep at a good pace by means of muscular contraction and dilatation acting on the rings, which carry on their under side the bristle-like processes above mentioned. These last operate as feet. The power of elongation is considerable, and the anterior part of the animal acts as an awl in penetrating the earth.

The earth-worm, as far as relates to its appearance above the surface of the ground, may be considered almost a nocturnal animal. In the night season, and at early morning, hundreds may be seen, though not one, unless they are disturbed either by moving the ground or pouring liquids into their holes, is to be found moving about during the day. The power of reproducing parts after mutilation is very great in this animal and the whole of the order.

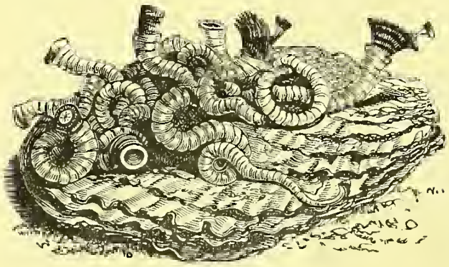
The worm-casts, which so much annoy the gardener by deforming his smooth-shaven lawns, are of no small importance to the agriculturist; and this despised creature is not only of great service in loosening the earth and rendering it permeable by air and water, but it is also a most active and powerful agent in adding to the depth of the soil, and in covering comparatively barren tracts with a superficial layer of vegetable mould. In a paper "On the Formation of Mould," read before the Geological Society of London, by Charles Darwin, the author commenced by remarking on two of the most striking characters by which the superficial layer of earth—or, as it is commonly called, vegetable mould—is distinguished. These are, its nearly homogeneous nature, although overlying different kinds of subsoil, and the uniform fineness of its particles. The latter fact may be well observed in any gravelly country where, although in a ploughed field, a large proportion of the soil consists of small stones, yet in old pasture-land not a single pebble will be found within some inches of the surface. The author's attention was called to this subject by Mr. Wedgwood, of Maer Hall, in Staffordshire, who showed him several fields, some of which a few years before had been covered with lime, and others with burnt marl and cinders. These substances, in every case, are now buried to the depth of some inches beneath the turf. Three fields were examined with care. The first consisted of good pasture-land, which had been limed without having been ploughed about twelve years and a half before. The turf was about half an inch thick, and two inches and a half beneath it was a layer or row of small aggregated lumps of the lime, forming, at an equal depth, a well-marked white line. The soil beneath this was of a gravelly nature, and differed very considerably from the mould nearer the surface. About three years since cinders were likewise spread on this field; these are now buried at the depth of an inch, forming a line of black steps parallel to and above the white layer of lime. Some other cinders, which had been scattered in another part of the same field, were either still lying on the surface or entangled in the roots of the grass. The second field examined was remarkable only from the cinders being now buried in a layer, nearly an inch thick, three inches beneath the surface. This layer was in parts so continuous that the superficial mould was only attached to the subsoil of red clay by the longer roots of the grass.


EARTH-WORMS (*Lumbricus terrestris*).

The history of the third field is more complete. Previously to fifteen years since it was waste land; but at that time it was drained, harrowed, ploughed, and well covered with burnt marl and cinders. It has not since been disturbed, and now supports a tolerably good pasture. The section here was turf half an inch, mould two inches and a half, a layer one inch and a half thick, composed of fragments of burnt marl (conspicuous from their bright red colour, and some of considerable size, namely, one inch by half an inch broad, and a quarter of an inch thick), of cinders, and a few quartz pebbles mingled with earth. Lastly, about four inches and a half beneath the surface was the original black peaty soil. Thus, beneath a layer (nearly four inches thick) of fine particles of earth mixed with some vegetable matter, those substances now occurred which fifteen years before had been spread on the surface. Mr. Darwin stated that the appearance in all cases was as if the fragments had, as the farmers believe, worked themselves down. It does not, however, appear at all possible that either the powdered lime or the fragments of burnt marl and the pebbles could sink through compact earth to some inches beneath the surface and still remain in a continuous layer; nor is it probable that the decay of the grass, although adding to the surface some of the constituent parts of the mould, should separate in so short a time the fine from the coarse earth, and accumulate the former on those objects which so lately were strewed on the surface. Mr. Darwin also remarked that near towns, in fields which did not appear to have been ploughed, he had often been surprised by finding pieces of pottery and bones some inches below the turf. On the mountains of Chili he had been perplexed by noticing marine shells, covered by earth, in situations where rain could not have washed it on them.

The explanation of these circumstances which occurred to Mr. Wedgwood, although it may at first appear trivial, the author does not doubt is the correct one, namely, that the whole is due to the digestive process by which the common earth-worm is supported. On carefully examining between the blades of grass in the fields above described, the author found that there was scarcely a space of two inches square without a little heap of the cylindrical castings of worms. It is well known that worms swallow earthy matter, and that, having separated the serviceable portion, they eject at the mouth of their burrows the remainder in little intestine-shaped heaps. The worm is unable to swallow coarse particles, and as it would naturally avoid pure lime, the fine earth lying beneath either the cinders and burnt marl or the powdered lime would, by slow process, be removed and thrown up to the surface. This supposition is not imaginary, for in the field in which cinders had been spread not only half a year before, Mr Darwin actually saw the castings of the worms heaped on the smaller fragments. Nor is the agency so trivial as it at first might be thought, the great number of the earth-worms (as every one must be aware who has ever dug in a grass-field) making up for the insignificant quantity of work which each performs.

On the above hypothesis, the great advantage of old pasture-land, which farmers are always particularly unwilling to break up, is explained; for the worms must require a considerable length of time to prepare a thick stratum of mould by thoroughly mingling the original constituent parts of the soil, as well as the manures added by man. In the peaty field, in fifteen years, about three inches and a half had been well digested. It is probable, however, that the process is continued, though at a slow rate, to a much greater depth; for as often as a worm is compelled by dry weather or any other cause to descend deep, it must bring to the surface, when it empties the contents of its body, a few particles of earth. The author concluded by remarking that it is probable that every particle of earth in old pasture-land has passed through the intestines of worms, and hence that in some senses the term "animal mould" would be more appropriate than "vegetable mould." The agriculturist, in ploughing the ground, follows a method strictly natural; and he only imitates in a rude manner, without being able either to bury pebbles or to sift the fine from the coarse soil, the work which Nature is daily performing by the agency of the earth-worm.

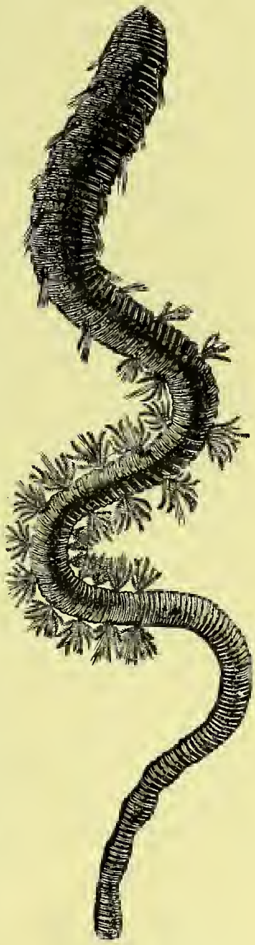


SERPULA VERMICULARIS.

ORDER III.—POLYCHÆTA.

The species here, in addition to having a very large number of bristles in each ring, and these arranged in bundles, have also their organs of respiration, in little tufts or gills, externally fixed on some one or more of the rings. This order contains some large and beautiful worms. Some are usually inclosed in a tube, others are free to move about. To the first group would belong the little shell-like Serpulæ, so often to be seen encrusting sea-weeds; to the latter, such species as the Bait or Lug Worm (*Arenicola piscatorius*). This species has no less than thirteen pairs of gills, and lives in holes excavated in the sea sand, which the worm forms with its head. The Telethusæ are called lug-worms by our fishermen; and, in an economical sense, they are the most valuable and important members of their class. Almost at any season, when the tide has withdrawn itself within the limits of the ocean, the idler who has wandered down to the shore may, perchance, notice a group of men, girls, and boys hieing thither with a glee that he might almost envy. Some carry a small spade, round and very sharp on the edge, and mounted with a long handle; and others have a little shallow bucket held by a twisted cord fixed in a hole on each side of the brim. They are a picturesque and a happy group. They go direct to a sandy bay which reaches from the shore to the lowest ebb, and is made a little sinuous by the ledge of rocks on each side that define its limits. Over this bay our group disperse themselves, every one, as his experience guides him, to the spot most favoured by the lug-worm. Here, either directed by some peculiarity in the holes on the surface, or often, as I think, by mere guess, the bait-seeker plunges his spade deep into the sand—not by pressure of the foot as a gardener does, but by force of the arm only—and then he throws out the sand, whence his attendant boy or girl picks out the wreathing worm and tosses it into a bucket, the bottom of which has been just covered with a little sea-water. Thus the work goes on as if it were a pastime, until the whole bay has been searched, and now unseemly pits and hillocks cover the entire surface. But the tide flows fast, and on its recess all is found to be again smooth and level, and no evidence remains to convict the spoilers of its tenantry.

This little bay—it may be fifty yards in breadth and four times that in length—will afford daily a crop of worms for several successive weeks; and, after an interval of a month's rest, other crops of equal abundance, and this from year to year immemorial. To account for the unfailing supply, our fishermen imagine that the worms come in from the sea with the tides; more likely it is dependent on the fecundity of the species, and the rapid growth of the individuals. The number taken is amazingly great. As a basis for the calculation let us take some small fishery, and let us estimate the boats engaged in the capture of fish that esteem the lug-worm a favourite food at the number of twelve only (we have in reality seventeen so engaged at present), and let us further suppose that each boat baits one line with its 700 hooks daily with the lug, and for the short period of six weeks per annum, and this low estimate will give an annual consumption of 302,400 worms! Now, again, multiply this great host by the numbers used in each of the fisheries that are carried on in almost every bay and creek of our island, and it will take a very long series of figures indeed to express the enumeration, such as sets the mind to wander vaguely amidst creations that are to it innumerable.


THE LUG-WORM.
(*Arenicola piscatorius.*)

The manner in which the lug-worm burrows may be thus explained:—An individual is laid by accident on the surface of the wet sand, and it wishes to bury itself underneath. The body is first disposed in an easy line, and then the anterior part moves of itself, and swells out to an oval shape, pointed in front. The proboscis is now extended, and a portion of the sand lying before it swallowed, so as to make a dimple in the surface. The bulged rings are now contracted, and the anterior, fashioned into a conical form, are thrust downwards by a successive series of muscular contractions, ring being pushed on after ring; for all the power is directed forwards by the animal, as the body is held steady, and hindered from being carried backwards by the protrusion and fixation of the bristles of the ventral series of feet. The anterior portion being in this manner buried, it is again dilated to the full, by which means the hole is enlarged, and the sand of the sides made more compact, and then this furrow is lined with a glutinous fluid exuded from the skin of the worm. Fixing again the buried part by the ventral feet, the same swallowing of sand and the same series of contractions are repeated; and thus the process is continued, until the whole body becomes concealed. From this account, it is obvious that the worm lives in the hole with the head downwards. Mr. Osler omits the most singular part of the whole process in his account of the method of the lug's boring, viz., the fact of its swallowing the sand immediately in front, and passing it through the intestinal canal. The worm "bores its way through the sand by means of the peculiar construction of the rings of its head, which, when elongated, has the shape of a regular cone. As each ring is so much smaller than the one behind it, as to admit of being received within it, the whole head, when completely retracted, presents a flat surface. When this disc is applied to the sand the animal, by gradually projecting the cone, and successively dilating the rings of which it is composed, opens for itself a passage through the sand, and then secures the sides of the passage from falling in by applying to them a glutinous cement, which exudes from its skin, and which unites the particles of sand into a kind of wall or coating. This covering does not adhere to the body, but forms a detached coherent tube, within which the animal moves with perfect freedom, and which it leaves behind it as it progressively advances; so that the passage is kept pervious throughout its whole length by means of this lining, which may be compared to the brickwork of the shaft of a mine or tunnel."

It will be noted, that by the process of dilating the anterior part, the calibre of the burrow is wider than is necessary to contain the body, but not wider than necessary to keep the branchiæ free from injury and friction, as the worm moves rapidly up and down in the tube. These delicate organs can even be displayed in full, and perform their important functions at whatever depth the worm may descend; and partly to protect them, and partly to filter the water that bathes them, the brushes of bristles that overhang them are protruded amidst and above the vascular filaments, and every bristle is barbed or feathered with lateral spines.

Quatrefages, in treating of the eyes in the species of this order, says:—"Ehrenberg has regarded as organs of vision certain coloured points which are met with in the margin of the umbrella in the medusæ, at the extremities of the rays in the star-fishes, in the head among the annelids, planarias, rotifers, &c., and at one of the extremities of the body in certain of the Infusoria. The accuracy of most of these statements was denied in the most positive manner, although often very unjustly. In proportion as these creatures have been more profoundly studied, it has been found, in the case of those animals whose size rendered them accessible to our methods of examination, that the greater number actually possessed true organs of vision. The most abundant evidence on this point has been contributed by naturalists of every European nation.

"The annelids more especially furnished me with a very striking example of this fact. One of the species, which lives in the Sicilian seas, possesses eyes which are almost as complete as those of a fish. I have succeeded in enucleating the crystalline lens, and in examining it separately, and I found, when it was placed upon a piece of thin glass which received the parallel rays transmitted to it by a plane mirror, it formed perfectly achromatic images. These images, repeated and magnified by the microscope, enabled me to distinguish with perfect clearness the very smallest details of the neighbouring coast, and by means of the crystalline lens of an annelid my microscope was thus converted into a telescope.

"The opposition which Ehrenberg met with was even more strongly marked when he announced that he had discovered an annelid (the amphicora), which carried at the end of its tail two eyes, which were perfectly similar to those which were upon its head. How, it was asked, were we to admit such a transposition of the senses? How was it to be supposed that eyes could exist at so great a distance from the brain, and without having any probable connection with it? The question was thus made a general one, and consequently acquired a very high degree of physiological importance. It was no longer sufficient to ascertain whether eyes did or did not exist, but it was now further necessary to decide if any one portion of the nervous system, excepting the brain, could become the seat of sensorial perception.

"If by the word eye we must understand an organ which is always the same, and everywhere similar to that which we find in man or birds, annelids, nemertes, planarias, and medusæ are certainly blind animals, but, like every organic apparatus, the visual organ may be simplified and degraded, without, on that account, changing its nature. Even in this state of degradation it maintains its fundamental parts, and these parts are generally easy of recognition.

"Although destined to fulfil a purely physiological function, the eye is a true physical apparatus. It always consists of a camera obscura, in which a converging lens concentrates the light, and throws the image of external objects on a screen which is placed in its focus. But here the lens, instead of being formed of inert matter, is organised, and is known as the crystalline lens. The screen is also living, and bears the name of the retina, and it is through the latter that the impression received from images is transmitted to the brain. However varied may be the degree of complication in an eye, its fundamental part always consists of a crystalline lens and a retina. We are therefore, on the other hand, bound to consider as a true eye every organ which possesses these characteristic elements; for it could not fulfil any other functions but those of which we have spoken. To decide this general question advanced by Ehrenberg, and to ascertain whether in fact the visual organ can be thus transposed (or, in other words, whether it can exist elsewhere than in the head), we must necessarily find in the amphicora, or in every other animal presenting analogous facts, the crystalline lens and retina of the eyes.

"In this respect my investigations continued for a long time to be unsuccessful. On the coasts of the Channel and of Sicily I had found many annelids allied to the amphicora, and bearing on the posterior extremity of their bodies the coloured points in question. In some of the species that I had discovered these coloured points were, moreover, strangely multiplied. There were several of them on the head, four at the extremity of the tail, and two on each ring of the body. This multiplication seemed to me to present in itself a very serious objection to the views of Ehrenberg. How was it possible to believe in such a profusion of visual organs? Yet the study of the living animals seemed to confirm this determination. I saw the tail fulfilling all the functions of the head, and this with evident proofs of spontaneity and intelligence. In moving, the tail went first, explored the objects without touching them, and turned aside from obstacles that lay in its path; in a word, it acted as if it were the seat of distinct vision, and as if it were directed by a clear will. Nevertheless, notwithstanding the many hours which I devoted to these observations, I was unable to discover either a crystalline lens or a retina; and hence my conviction in reference to so delicate a question as this could not be conclusive.

"At length among the corallines, those small algæ which cover the rocks with their closely compressed tufts, as the moss mantles the stone, I discovered the Polyophthalmians (*Polyophthalmia*). Here there was no longer any room for doubt; the fable of Argus was realised before me on the most incontestable evidence. Imagine to yourself a nearly cylindrical little worm, of a golden yellow, about an inch in length, and armed with two rows of setæ, whose length increased from before backwards, and you may perhaps form some idea of the aspect presented by the polyophthalmian in a state of repose. In the sand where it passes its life this animal moves with incredible rapidity, by means of the general contraction of its body, and the setæ which serve it in place of feet; but as soon as it wishes to swim freely in the water, or merely to place itself in such a manner that the little animals with which it is nourished may be within reach of its mouth, two large ciliated structures, which are placed on the sides of its head, are protruded, and act like the two paddle-wheels of a steamboat.

"With a view of directing its course, the polyophthalmian is provided on its head with three eyes, each of which is furnished with two or three voluminous crystalline lenses, very easy of recognition. Besides this, on each side of the rings of its body there appears a red point, very similar to those of certain of the Amphicoræ. On dissection, we find that each of these points receives a large nerve issuing from the ganglion, or ventral nervous centre corresponding to it. By the help of the microscope, we can see that this nerve penetrates into a mass of pigment, which encloses a spherical crystalline lens, and we now see that the textures lying before it have undergone a modification by which they are rendered more completely and equably transparent. In a word, we can no longer doubt that these red points, which are placed on the sides and along the whole of the body, are true eyes, receiving their optic nerves from the abdominal nervous centres, and having no direct connection with the brain."

CLASS II.—ROTIFERA.

This class is well known to microscopists as containing the wheel-animalcules. These are very minute animal forms, the largest being scarcely more than just visible to the unassisted human vision. The name is given to them from the wheel-like disc to be found at the anterior extremity of the little animal's body, which is capable of being inverted and everted, and the margin of which is lined with wonderfully minute vibratile cilia. When these cilia are set vibrating, there is an optical illusion, as though a toothed wheel were revolving with great velocity in a circle. This motion is subject to the will of the animal. In most there is a tail appendage, which ends in a forceps, by means of which the animal can lay secure hold of any minute foreign bodies. Some of these Rotifera form houses, in which they live. These may be of wondrous transparency (Floscularia), or built up of minute particles of foreign substances (Melicerta). Some few live in colonies, the whole colony being capable of motion (Conochilus), or they lead an independent life, each cruising on its own account. The first form known (*Rotifer vulgaris*) was discovered by Leeuwenhoek in 1702. He observed that this animal, which he had found in a leaden gutter of his house, after it had been dried with the sand and other matters that adhered to it, revived again when after two days he poured water upon it, which, having been previously boiled, could contain no living animalcule. He afterwards found that the same phenomenon occurred after a lapse of five months. Different observers repeated these experiments. Fontana found wheel-animalcules that had been dried for two years and a half revive on being moistened; and Spallanzani saw the waking from slumber occur even after four years. The last-named observer saw the same phenomenon many times in succession; nay, even eleven times he saw alternately apparent death and life. A few minutes are often sufficient to revive the creatures; but such alone as were surrounded with sand and other matters—not those which, lying quite bare, had been dried—are ever revived. Von Humboldt calls the state of apparent death in these animals one of sleep, or of suspended life. In this desiccated state life is potentially present, but does not announce itself by actual phenomena. If we choose to name this life latent, we must not call death itself a latent life. Certainly these animals are not dead, but their life is brought to a standstill by the want of one of the most common and most necessary of vital stimuli—by the want of water.

CLASS III.—GEPHYREA.

The species belonging to this class are marine worms, with cylindrical bodies, and their mouths are furnished with a proboscis that can be withdrawn, and around the mouth is a row of simple tentacles. They vary much in shape; one, from its general resemblance to a spoon, is known on the coast of the South of England as Neptune's Spoon-worm (*Thalassema neptuni*). Some live in the empty shells of molluscs. Another species (*Sipunculus edulis*) is said to be eaten by the Chinese. Many zoologists place this class near the Holothuroids, an order of the Echinoderms; and Forbes includes them in his "History of the British Sea Urchins," introducing them by the statement, "here Radiism sets and Annulism begins;" and heading this with an appropriate woodcut, in which the same idea, after another fashion, is set forth.

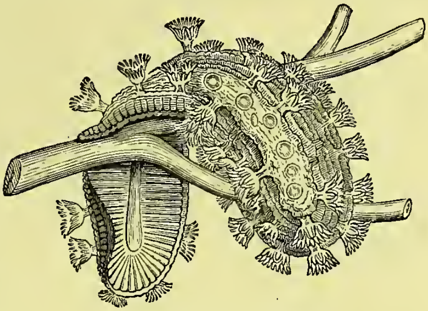
CLASS IV.—RHYNCHOCŒLA.

These are the flat worms. To one section thereof would belong the Turbellarian and Nemertean worms. To the former belong a number of small, soft, often ribbon-like worms, with ciliæ all over their bodies. Their integument is highly cellular, and sometimes contains the same kind of green chromules that are so characteristic of plants. To this section belong the Land Planaria. In one of these we figure (*Bipalium grayii*) the head is strangely hammer-shaped. To the latter group belong some often large worms, with very brittle bodies, mostly marine, some of them with vivid colours. Borlasia angliæ, one of these, grows to more than four feet in length.

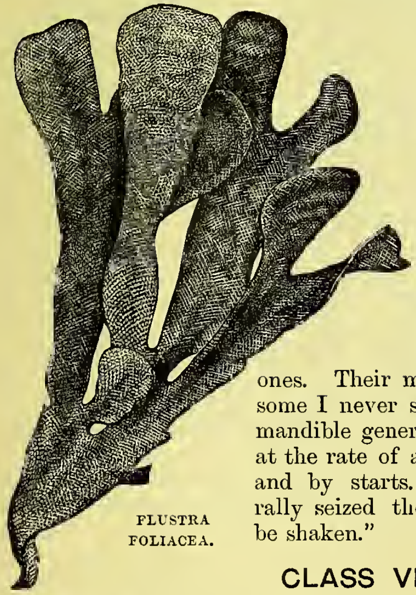
BIPALIUM GRAYII.

CLASS V.—POLYZOA.

As we have observed, when treating of the Mollusca, the species belonging to this class are by very many zoologists placed in a group of that sub-kingdom called the Molluscoidea. With a few exceptions, they are marine animals, mostly living in colonies. They were, before Ehrenberg separated them, included with species forming the next sub-kingdom. The little animals are included in cup-shaped receptacles, formed either of a substance called chitine or with a calcareous substratum. Each little polype is lodged thus in a cell, and it possesses a crown of hollow tentacles, varying much in number. The disc on which these tentacles are fixed is horseshoe-shaped in nearly all the fresh-water species, or circular, as in nearly all the marine forms. Some very few (as *Cristatella mucedo*) can glide along almost snail-like; but the most of them spread over foreign bodies, as seaweeds and univalve shells; and some (like *Flustra foliacea*) form erect branching masses. Darwin, who examined some of these creatures very minutely, tells us that "several genera (Flustra, Eschara, Cellaria, Cresia, and others) agree in having singular movable organs attached to their cells. These organs in the greater number of cases very closely resemble the head of a vulture; but the lower mandible can be opened much wider than a real bird's beak. The head itself possesses considerable powers of movement, by means of a short neck. In one, Polyzoon, the head itself was fixed, but the lower jaw free. In another it was replaced by a triangular hood, with a beautifully-fitted trap-door, which evidently answered to the lower mandible. In the greater number of species each cell was provided with one head, but in others each cell had two.

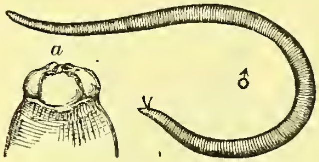

CRISTATELLA MUCEDO.

"The young cells at the end of the branches of these Polyzoa contain quite immature forms, yet the vulture heads attached to them though small, are in every respect perfect. When the animal was removed by a needle from any of the cells, these organs did not appear to be in the least affected. When one of the vulture-like heads was cut off from a cell, the lower mandible retained its power of opening and closing. Perhaps the most singular part of their structure is, that when there are more than two rows of cells on a branch, the central cells were furnished with these appendages of only one-fourth the size of the outside ones. Their movements varied according to the species; but in some I never saw the least motion, while others, with the lower mandible generally wide open, oscillated backwards and forwards at the rate of about five seconds each turn; others moved rapidly and by starts. When touched with a needle, the beak generally seized the point so firmly that the whole branch might be shaken."


FLUSTRA FOLIACEA.

CLASS VI.—NEMATELMINTHEA.

This class is known as containing a number of round-bodied, elastic, parasitic worms. They are parasitic in the digestive organs of insects, of fish, birds, and mammals, not excluding man. They will sometimes even get into the skull-cavity of animals. One species (*Strongylus gigas*) lives in the kidneys of man and of different mammalia, and attains to a length of from one to two feet. The well-known Round Worm (*Ascaris lumbricoides*) lives in the intestinal canal of man, and grows to upwards of fifteen inches in length. Another (*Oxyuris vermicularis*), which is vastly smaller, lives in the human large intestine, and is especially troublesome in infancy. The Thread Worm (*Gordius aquaticus*) is viviparous, and the young differ in form from the mother. The Guinea Worm (*Filaria medinensis*) lives in man under the skin in the cellular tissue, especially in the legs, and may attain a length of ten feet. Male individuals of this species do not seem to have been observed hitherto. Sometimes this worm occasions severe pain. It is met with in hot countries, especially of the Old World, less frequently in America, except in the island of Curaçao, where it is endemic, although the worm-sickness does not always prevail there with the same intensity.

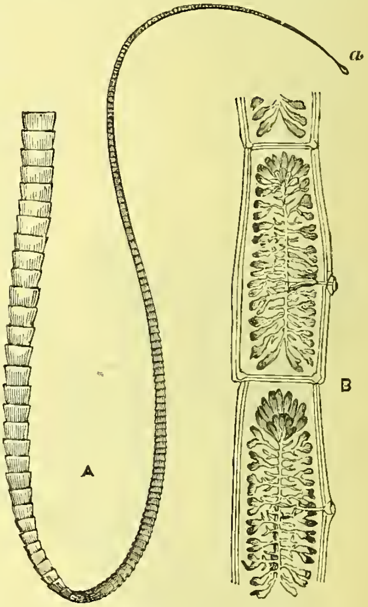


ROUND WORM. (*a*) *Mouth enlarged.*

Here, also, is to be placed the Microscopical Worm (*Trichina spiralis*), found by Professor Owen in the human muscle, said to be got by eating uncooked pork, and causing even death. And here the insect parasites belonging to the genera Gordius (Horsehair Worm), Mermis, and Sphærularia.

CLASS VII.—PLATYELMINTHEA.

Of these parasites there are the Trematodes and the Cestoid worms. To the former belong the flattened fluke-like forms too often found in the livers of our ruminating animals, such as the ox and sheep, and even in that of man. Some of them are external parasites, living on or near the gills of fishes (Tristoma). But it is to the latter group that some of the most annoying parasites belong. The Cestoid worms are flat and tape-like, whence the name tape-worm. They are segmented forms, with no special digestive or circulatory system. They live by imbibing nourishment through their thin integument. The first segment, frequently called the head or nurse, is armed with hooks of chitine, and furnished with suckers. From it the rest of the segments grow. There are very many species. The Broad Tape Worm (*Bothriocephalus latus*) lives in the small intestines of man, and sometimes attains a length of twenty feet. It is, fortunately, rarely to be met with in this country, being a native of Russia and Switzerland, though it occurs occasionally in Holland. The common Tape Worm (*Echinotænia solium*) also lives in the small intestines of man. It is common in great Britain, and is easily distinguished from the Broad Tape Worm, not only by its "head," which wants the opposite bothria, or little fossettes, but also by the joints being narrower, and being in the common worm longer than they are broad, while in the broad worm they have more breadth than length. The larval stage of the common tape-worm, it is now known, is the parasite present in measly pork. The disease known as "staggers" in sheep is caused by the larval form of a tape-worm (*Echinotænia cœnuris*), which is a parasite of the dog. A lesson is to be here learnt by the breeders of both pigs and sheep.



JOINTS OF TAPE-WORM.
A. Head (*a*), and a number of joints of body.
B. Microscopical structure of portions of three joints.

SUB-KINGDOM VI.—COELENTERATA, OR ZOOPHYTA.

In this sub-kingdom we venture to include the three great classes of—1. Actinozoa, or Corals; 2. Hydrozoa, or Hydra-like Polypes; and 3. Porifera, or Sponges. In all of these we find an organisation very different and much lower in type than the mean average type in the previous sub-kingdom. In this sub-kingdom that plant-like form of development known as the vegetative form of development, by which large colonies or masses are formed, by a process of budding, is the rule. Scarcely a trace of a specialised nervous system is to be met with. The alimentary system is in many reduced to the lowest possible expression; indeed, there is in some no special mouth or stomach-cavity. The muscular system, though well marked in some, in others cannot be said to exist; at least, there are no very specialised forms of tissue. Lowly organised as these forms are, they, by their rapid powers of increase, and by the powers which many of them possess of depositing calcium carbonate, taken up from the medium in which they live, in their tissues, or spicules of silix, amid their soft protoplasm, build up such huge structures as to form a very important part in the formation of our world. A large volume might be written about this sub-kingdom; here we can only notice a few of the more important species belonging to each class. The outer surface of the tegumentary layer (ectoderm) varies a good deal in this sub-kingdom. In the classes Actinozoa and Hydrozoa it is very rarely ciliated; but in these we find almost constantly the presence of stinging cells (cnidæ), either scattered or in clusters. These consist of minute sac-like bodies, in the interior of which is coiled up a long barbed thread. The slightest pressure easily ruptures these cells, whereupon the thread is at once uncoiled, bounding with force against the opposing surface. These threads are used for paralysing the prey on which the animals feed. In the class Porifera there are no cnidæ (with one or two exceptions), and the outer surface is non-ciliated.

CLASS I.—ACTINOZOA.

This class contains the corals. The bodies of the coral polypes end in an oral (mouth) region, around which are placed a number of tentacles or feelers. The mouth leads into a stomach, which is suspended in the general body-cavity of the polype, and this space around the stomach is divided into compartments, so that in a cross section the body would seem to be composed of two tubes, one inside the other. A skeleton is often formed in the outer layer. Sometimes this is only formed of little masses of carbonate of lime, called spicules (Alcyonium). Sometimes these become fused into a more or less solid tubular mass (Tubipora); sometimes there may be horny portions alternating with calcareous portions (Isis); or the whole skeleton may be formed of chalky deposits, as in the Madrepores.

Up to the middle of the last century, it was the prevailing view that these corals belonged to the vegetable kingdom. Marsigli, in 1706, observed on the shore of the Mediterranean some of these forms (Alcyonium, Corallium, Antipathes), and he found in their pores little bodies that contracted when the stem was removed from the water. Such bodies or buds he took to be flowers, and so believed that at length the view was definitively established which consigned these marine products to the vegetable kingdom. But still the animal odour that was observed opposed itself to this view, as well as the chemical investigations of Geoffroy, of Lemery, and of Marsigli himself, which demonstrated ammoniacal constituents in these supposed sea plants, just as in animal substances. Peysonnel, a physician of Marseilles, observed at that place (1723) the Blood Coral, and afterwards on the coast of Northern Africa he examined different Madrepores and Millepores. The result was that he found Marsigli's plants to be animals, and named them *Orties Corallines.* He imparted his discovery to Réaumur, to whom the notion seemed so improbable, that in a short notice of it which he gave in the "Memoirs of the Academy of Sciences," at Paris, 1727, he felt bound to suppress the discoverer's name. Shortly afterwards, when Peysonnel's discovery had been forgotten, Trembley found in our country the fresh-water polype, and communicated his observations to Réaumur. In the following years, Bernard de Jussieu, the celebrated botanist, investigated Alcyonium (Lobularia), Flustra, and Tubularia, on the coast of Normandy, and confirmed Peysonnel's discovery; whilst Réaumur also adopted his views. Linnæus, accordingly, transferred the corals and stone-plants to the animal kingdom; and thus more than half a century was required to effect the adoption by science, as a firm truth, of that view which Ferrante Imperato had announced at the beginning of the sixteenth century. Ellis, Pallas, Cavolini, and other authors, in the latter half of the past century, extended and multiplied our acquaintance with these interesting marine animals, of which the investigation still affords to naturalists of the present day a rich material for new and important discoveries. In some the tentacles are simple and multiples of six. In others the tentacles are pinnate, or feathered, on the edge, and in multiples of eight.

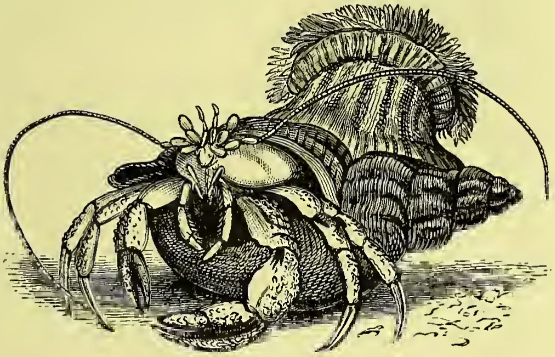
VARIOUS SPECIES OF SEA ANEMONES.

SUB-CLASS I.—ZOANTHARIA.

All the species in this sub-class are marine. The tentacles are simple, and in multiples of six, and except in the third order there is no horny axis.

ORDER I.—MALACODERMATA.

This order is so called from its containing soft-bodied forms like the common sea anemones. Some of these, like the common red sea anemones, adhere by means of a flat disc; some are oceanic swimmers; some, like the following species, described by P. H. Gosse, are carried about in a quasi-epiphytic manner. The Parasitic Anemone (*Sagartia parasitica*) "is found," writes Mr. Gosse, "exceedingly abundant in Weymouth Bay, extending from the deep water of the offing even into the narrow harbour; but I have never heard of its being found within tide-marks, except in the instance of the variety ameythystina, which indeed was found attached to a stone at low water-mark. It is, as its name imports, normally parasitic in its habits, though not so strictly but that we frequently dredge specimens adhering to stones; and in captivity it is by no means uncommon for an individual to detach itself from its native site and adhere to the bottom of the vessel, or even to crawl up the perpendicular side. Generally, however, it is found seated on some univalve shell, which is tenanted by a soldier-crab: young specimens on Turritella terebra, Trochus magus, T. ziziphinus, &c.; but adults, which are much more frequently met with than the young, almost invariably on the Great Whelk (*Buccinum undatum*). The dredge, indeed, often brings up shells invested by this anemone, which are empty; but I believe in every such case the shell has recently been vacated by the soldier, and that the Sagartia never voluntarily selects either an empty shell, or one tenanted by the living mollusc, for his residence. I have been favoured with a humorous sketch of the ways of this loving pair—Crab and Zoophyte, *Arcades ambo*—which bears on the matter before us. The following scene was also witnessed by my much lamented friend, Dr. R. Ball. One of the specimens referred to, attached to the dead shell of a Buccinum undatum, which had, from its appearance, been in all probability just deserted by a Pagurus, was placed in a glass aquarium. In a short time the anemone left the Buccinum, and attached itself to the side of the tank. It next deserted this position, and fixed itself on the side of a large stone that filled the centre part of the aquarium. After the lapse of some weeks, a hermit crab was dropped into the tank (I think *Pagurus bernhardus*). Well, if these hermits can't live without hiding themselves in the deserted shell of some poor mollusc, I think it is equally true that they can't live happy until they hide both themselves and their shells in some quiet little hole in the rockwork of our aquaria, from whence they can look out, and, thinking that the super-imposed stonework adds vastly to the strength of their fortification, experience sundry intense feelings of safety. Be this as it may, the hermit in question was not long ere he walked up to a little grotto that was in the rockwork of the aquarium (quite close to the Sagartia parasitica); and, after a slight survey, to see that all was right, he turned his left shoulder forward and backed in. Then he began to whisk his antennæ and foot-jaws in a dreadful manner, and looked evidently quite content. I suppose this was a state of things the parasite perched on the rock above had long been waiting for, for it was not long in moving its disc over the top of the small whelk; and before the crab knew where he was, the big Sagartia had pitched his tent on the roof of the hermit's house. Where the hermit crab goes there goes the Sagartia; a quiet life it had before, a restless one it has to lead now. But doubtless it knows what's best for it."


SAGARTIA PARASITICA ON BUCCINUM.

The crab who sustains the honourable office of porter to this species is invariably the brawny-limbed Pagurus bernhardus, as P. Prideauxii is favoured with the support of another species, Adamsia palliata. In the rude and blundering manner in which the bearer performs his office, it cannot be but that the poor anemone sustains many a hard knock and many a rough squeeze among the rocks and stones over which his servant travels; but he appears to bear these mischances with great philosophy. I know of no species which live so constantly exposed. A rude shock will, indeed, cause it to withdraw its tentacles, and contract its disc into that button-shape which is common to the tribe, but this is only for a moment; it constantly expands again, and remains full blown in spite of all its draggings hither and thither. Its skin is peculiarly tough and leathery, a provision, doubtless, against the accidents to which its vagrant life exposes it.

ORDER II.—SCLERODERMATA.

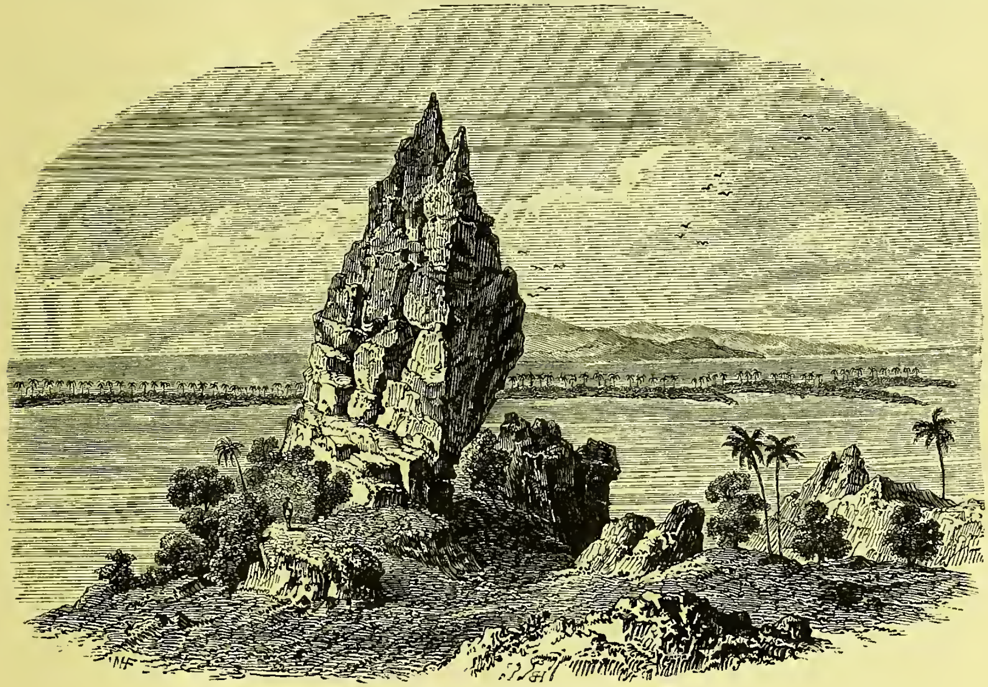
This order receives its name from the continuous chalky skeleton which the polypes belonging to it form. It includes the reef-building corals. A fringing reef is thus beautifully described by my friend the late Professor Jukes:—"I had hitherto been rather disappointed by the aspect of the coral reefs, so far as beauty was concerned; and though very wonderful, I had not seen in them much to admire. One day, however, on the lee side of one of the outer reefs near the wreck of the *Ferguson* I had reason to change my opinion. In a small, bight of the inner edge of this reef was a sheltered nook, where the extreme slope was well exposed, and where every coral was in full life and luxuriance. Smooth round masses of mæandrina and astræa were contrasted with delicate leaf-like and cup-shaped expansions of turbinaria, and with an infinite variety of branching madreporæ and seriatoporæ, some with mere finger-shaped projections, others with large branching stems, and others again exhibiting an elegant assemblage of interlacing twigs, of the most delicate and exquisite workmanship. Their colours were unrivalled vivid greens, contrasting with more sober browns and yellows, mingled with rich shades of purple, from pale pink to deep blue. Bright red, yellow, and peach-coloured nulliporæ clothed those masses that were dead, mingled with beautiful pearly flakes of eschara and retepora ; the latter looking like lacework in ivory. In among the branches of the corals, like birds among trees, floated many beautiful fish, radiant with metallic greens or crimsons, or fantastically banded with black and yellow stripes. Patches of clear white sand were seen here and there for the floor, with dark hollows and recesses, beneath overhanging masses and ledges. All these, seen through the clear crystal waters, the ripple of which gave motion and quick play of light and shadow to the whole, formed a scene of the rarest beauty, and left nothing to be desired by the eye, either in elegance of form or brilliancy and harmony of colouring.

"This beautiful portion is, however, only to be seen on the extreme verge and outer slope of a coral reef, when circumstances are favourable for its examination, which is not often the case. The flat surface of the reef is a dull affair enough, though many elegant corals may be seen in the detached pools, or in the parts which are permanently covered by water. I spent a long time at low water, wading about on the higher pinnacles of the coral and collecting specimens. These, however, when dry, lose half their beauty, from losing all their colour, which seems to belong wholly to the animal matter. Madrepore branches, the living tips of which were of rich blue, gradually faded towards the dead base into the yellowish white of the corals in our museums at home. Unfortunately, the finest and most beautiful specimens require so much space, both to dry them at first and to pack them afterwards, that their transport is difficult, and in a small man-of-war impossible. The smell of the animal matter also, while the corals are drying, is most sickening.

"I observed to-day that some considerable portions of coral, all alive and coloured, were left by the tide six or eight inches above the water, and remained so till it returned, or for nearly an hour. They did not seem injured by the exposure, which of course must frequently occur. I often observed the same fact, both before and since, and believe that an exposure of two or three hours to the air and the sun will not kill many of the coral polypes, as long as they are left in the position of growth, and their cells thus retain the moisture. Perhaps some portion of the common body remaining under water may be essential ; but I have seen blocks of living astræa, with the green animals in their cells, the top of which was eighteen inches above the water, and, if I recollect rightly, the base also was dry.

"The reef was about a quarter of a mile wide, and ran nearly due north and south for several miles. It appeared, indeed, to stretch to the horizon in both directions, the breaks in its continuity being so narrow as to be barely perceptible. A fresh breeze was blowing from the south-east, and rather a heavy sea running outside. The water was perfectly clear, and of great and almost unfathomable depth right up to the outer slope or submarine wall of the reef. The long ocean swell being suddenly impeded by this barrier, lifted itself in one great continuous ridge of deep blue water, which, curling over, fell on the edge of the reef in an unbroken cataract of dazzling white foam. Each line of breakers was often one or two miles in length, with not a perceptible gap in its continuity. After recovering from this leap, and spreading for some distance in a broad sheet of foam, the wave gradually swelled again into another furious breaker of almost equal height and extent with the first, and then into a third, which, although much less considerable, yet thundered against the bows of the wreck with a strength that often made her every timber quiver. Even then the force of the swell was not wholly expended, two or three heavy lines of ripple continually traversing the reef, and breaking here and there against the knobs and blocks of coral, that rose higher than usual. There was a simple grandeur and display of power and beauty in this scene, as viewed from the forecastle of the wreck (about thirty feet above the water), that rose even to sublimity. The unbroken roar of the surf, with its regular pulsation of thunder, as each succeeding swell first fell on the outer edge of the reef, was almost deafening, yet so deep-toned as not to interfere with the slightest nearer and sharper sound, or oblige us to raise our voices in the least. Both the sound and the sight were such as to impress the mind of the spectator with the consciousness of standing in the presence of an overwhelming majesty and power, while his senses were delighted by the contrast of beautiful colours afforded by the deep blue of the ocean, the dazzling white of the surf, and the bright green of the shoal water on the reef.

"The reef, when closely examined, appeared to consist of a sandy floor, on which were thickly clustered clumps of corals, scattered closely but irregularly about it. The corals appeared principally rounded masses of astræa and mæandrina, covered with their green-coloured animals in a state of expansion; there were, however, many finger-shaped madrepores of beautiful purple colours, and leaf-like expansions of turbinaria and other branching corals. These were now generally covered with from one to four feet of water, but some masses were level with its surface. The whole was chequered with spaces of white sand, had a bright grass-green hue when viewed from a distance, and when looking down on it from the poop of the wreck, might have been likened to a great submarine cabbage garden.



A FRINGING CORAL REEF.

"As I was walking the poop of the second wreck before looking out for a 'soft plank' to sleep on, I could not help being struck with the wildness and singular nature of the scene. A bright fire was blazing cheerfully in the galley forward, lighting up the spectral-looking foremast with its bleached and broken rigging, and the fragments of spars lying about it. A few of our men were crouched in their jackets under the weather-bulwarks, as a protection from the spray which every now and then flew over us. The wind was blowing strongly, drifting a few dark clouds occasionally over the star-lit sky, and howling round the wreck with a shrill tone that made itself heard above the dull continuous roar of the surf. Just ahead of us was the broad white band of foam which stretched away on either hand into the dark horizon. Now and then some higher wave than usual would burst against the bows of the wreck, shaking all her timbers, sending a spout of spray over the forecastle, and travelling along her sides would lash the rudder backwards and forwards with a slow creaking groan, as if the old ship complained of the protracted agony she endured.

"She had been wrecked since we had ourselves left home, and entered the southern hemisphere, and there mingled perhaps some speculations as to our chance of leaving the old *Fly* in some similar situation, with the highly-wrought feelings which the mere character and aspect of the scene sufficed to impress upon the mind. The place was so far removed from the regions of civilised life, and so far even from dry land at all; the reef, also, on which we stood, was one of Nature's mysteries, its origin equally wonderful and obscure, its extent so vast, and its accompaniments so simple, so grand, and appropriate; altogether, I shall not easily forget my night walk on the weather-beaten poop of the wreck of the *Martha Ridgway.*"

ORDER III.—ANTIPATHARIA.

This order contains a number of polypes with a solid often dark-coloured axis, which often branches and forms an irregular network, though sometimes the axis is unbranched, and in other cases it is spirally twisted.

SUB-CLASS II.—ALCYONARIA.

To this sub-class belong those Actinozoa, the polypes of which have eight tentacles, and these are mostly fringed. The skeleton is generally made up of spicules, and is very rarely continuous. All are marine. There are at least the following orders:—

ORDER IV.—ALCYONIACEA.

In this order we have the families Cornularidæ, Alcyonidæ, and Tubiporidæ. In the second family are to be found the common Dead Man's Toes (*Alcyonium digitatum*), so often cast upon our sandy shores after a gale.

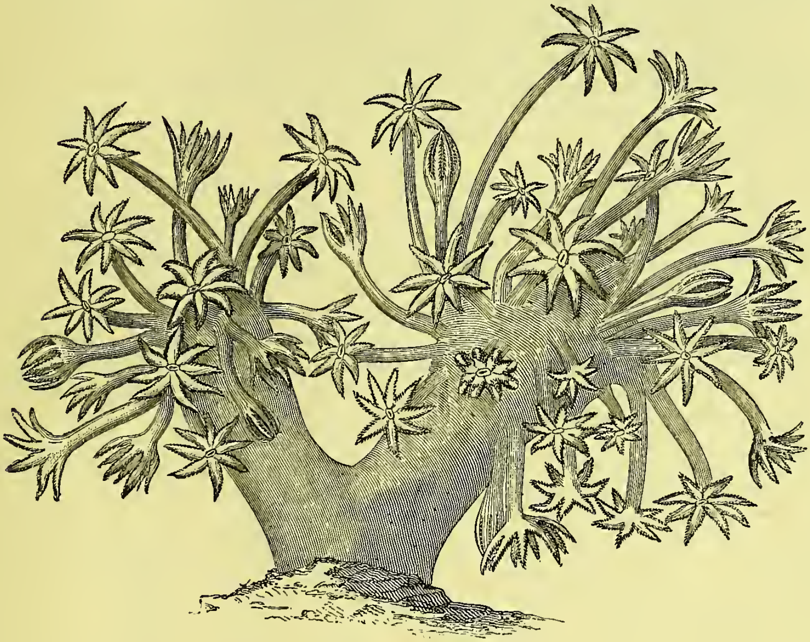
"At low water, after an unsuccessful hour spent in turning stones, I went," says Mr. Gosse, "to the end of the rocks at Petit Tor, and by leaping over an inlet through which the tide was pouring, reached a mass of rock covered with Fuci and Laminariæ. Here, growing on the side of a deep hole under water, illuminated by light proceeding from the far end of the cavernous passage, I had for the first time the pleasure of seeing Alcyonium digitatum. It was composed of two cylindrical lobes, rounded at the ends, their form suggesting both of the names vulgarly applied to this Zoophyte —of Dead Man's Fingers, and Cows' Paps; or the more elegant appellation, assigned to it by Sir John Dalyell, of Mermaid's Glove. By lying down and creeping beneath a ledge of rock, and thrusting my arm under the hole, I succeeded in laying hold of it, and easily detached it from its base without laceration. My basket of bottles being at a distance, I gently put my prize into my coat-pocket, until I could again immerse it in clear sea-water. The lobes were now contracted, about as large as a man's forefinger, of a cream-white hue, of a smooth surface, except that it was covered with slight depressions of a long oval form, divided by narrow angular lines. In this state I brought it home, and placed it in a glass vase of clear sea-water.

"After a few hours, how different was its aspect! I will endeavour to describe it as it lies now before my eye; and the more willingly, because neither any description that I have met with, nor any figures, give an adequate idea of either its form or its surpassing beauty.

"I do not mean that its general form and structure are not correctly stated, but that the details of the beautiful flower-like polypes themselves are not given with accuracy. The fingers, or lobes, are now greatly swollen, both in length and thickness, the colour is of a much purer white, and the substance is almost pellucid, especially in those oval, or rather polygonal depressions, which I have mentioned above, and which are the terminating cells of the aqueducts that run through the whole system. They are now, however, depressions no longer; for from each has protruded a polype, which resembles a flower of exquisite beauty and perfect symmetry. But how shall I describe one of these? From each of the cells springs a clear white tube, translucent, but not perfectly transparent, and yet sufficiently so to reveal with perfect distinctness the few and simple organs contained in the interior. Its base is commensurate with the margin of the cell from which it springs;

but it tapers upward to the length of nearly half an inch, where it dilates into a flower of eight slender and pointed petals, which diverge into a trumpet-form. Each slightly bulges outward at its junction with the tube, so as to give a somewhat campanulate outline to the flower; indeed, the resemblance to the blossom of a campanula is sufficiently striking. Examined with a lens, each petal is perceived to be furnished, on each of its two lateral margins, with a row of delicately-slender pinnæ, or filaments, which are short at each extremity, but increase in length, in regular gradation, towards the middle of the petal. These pinnæ do not proceed in the same plane, but arch outwards, so as greatly to increase the elegance of the flower. Submitted to a higher power, the pinnæ are seen to be roughened, throughout their whole length, with numerous prickly rings, somewhat like the horns of an antelope. The whole appearance is very different from the broad petals, notched along each edge, which are commonly represented.

"The pinnæ are capable of independent motion; one being frequently jerked inwards towards the centre of the disc, while its fellows on each side remain motionless. I cannot detect any appearance of cilia on them, nor do I think there are any, for I have seen minute suspended particles slowly sink, till they rested on the pinnæ, without the least indication of a vortex or current in the water.



AN ALCYONID.

"The beautiful form of the petals above described is quite lost after the animal has been about a day in captivity. In both of my specimens, though the water has several times been renewed, the petals after the first day shrank up into short, thick, unshapely masses, rudely notched at their edges, and never afterwards expanded more than this, though apparently healthy in other respects, and sufficiently sensitive to handling. Probably the defect in extant representations arises from the figures having been copied from specimens in this condition.

"In the centre of the floral expansion a narrow slit opens into the stomach, a cul-de-sac of the same narrow form, viz., that of a sack when empty, or of a pillow-case as it comes from the laundress, flat, thin as viewed in one aspect, and wide in another at right angles to it. At the bottom it is truncate; and from hence spring off, arching downwards, three threads on each side, which are thickened and much contorted in their course. These threads appear to form the edges of so many delicate membranes, which run up as septa, connecting the stomach with the exterior parietes of the body, and dividing the whole of the space surrounding this viscus into chambers, perfectly isolated. With a strong light behind the animal, I distinctly perceived a ciliary vibration down the interior of the stomach, at least at the two sides when viewed transversely.

"The septa are eight in number, but two in every polype are destitute of the contorted threads; which, I am inclined to think, when present, run between the sides of each septum, this consisting of two membranes; but of this I am not quite certain.

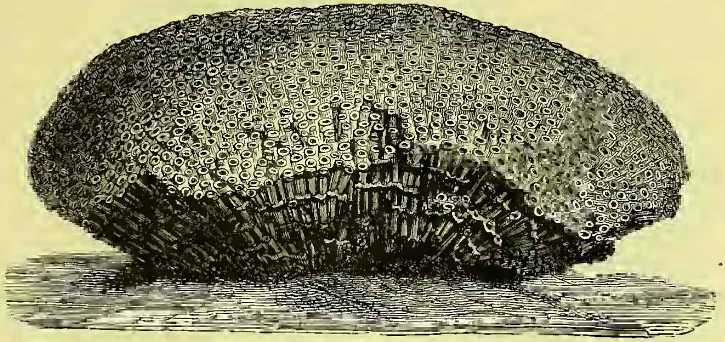
"The base of each polype does not rest, like an independent body, on the surface of its cell, but springs from the circumference of the cell, each polype base being actually contiguous to, and in fact continuous with, its surrounding neighbours. The polype-skin is really a prolongation of the common integument of the mass.

"Under a power of 220 diameter, a living polype showed a current along the pellucid skin, minute globules being carried both upwards and downwards, with a motion much like the circulation in Chara, &c. I saw it most distinctly near the basal part of the animal, but whether it was within the substance of the skin, or along the interior surface, I could not be absolutely certain. It was a very different motion from the close and rapid ciliary waves of the stomach, which were plainly visible in the same animal. The currents must, however, be in the cavity; for I observed the globules follow the outline of one of the tortuous threads, and also that of the angle of the stomach, whence I must conclude that the whole of the interior surface, as well as the various organs, is covered with vibratile cilia of excessive tenuity.

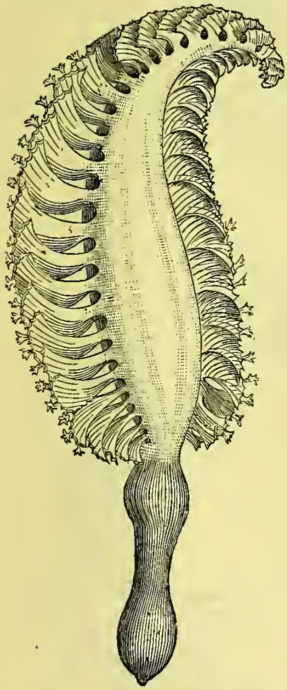
"Around the neck of the expanded polype, that is, just below the base of the petals, there are to be seen, by means of a lens, a number of short lines placed transversely. With a higher power, on the animal being subjected to pressure, these are found to be calcareous spiculæ, arranged in a singular manner. They are fusiform, and slightly knobbed. The basal part of the animal is also studded with minute points; these likewise prove to be spiculæ, but of different form and appearance, each consisting of a star of six points, all truncate and digitate. These are scattered all over the base, for about one-fourth of the height of the polype, but there are rounded accumulations or constellations of these stars among the rest, where they are densely crowded together. These clusters seem to be arranged one in each interspace of the septa; the former kind runs up in points into the base of each petal.

"When the polypidom is carefully cut open lengthwise, it is seen to be permeated by canals running throughout from the base to all parts of the surface, where they dilate a little and form the cells which contain the several polypes. Under a microscope, the substance which separates the cells is seen to be spongiose, containing a great number of spiculæ of much larger size than those of the polype-skin. They vary in form, but follow one model, and much resemble very gnarled branches of oak, with the branchlets broken off, leaving ragged ends.

"The beautiful Organ-pipe Coral (*Tubipora musica*) of the Red Sea and Indian Ocean belongs to the third family. All along many of the fine sandy bays of Mahé and Praslin, in the Indian Ocean, I found masses of various sizes of the bright-red skeleton of this well-known coral; and in some places the finely broken-up fragments were so mixed up with the sand as to impart to it a slight red colour. Finding the skeleton so common, I expected with a little search to discover the living coral *in situ*, and with this object in view I searched many a mile of coral-reef, but without success. Hearing from some of the fishermen that, on a bank famous for such fine fish as Mesoprion erythrinus, Gerres argyreus, &c., quantities of red coral were often brought up on their hooks, I proceeded to the spot, and found large quantities of the skeletons of Tubipora musica, but no trace of the polypes. In October of 1867 I was residing on the eastern side of Praslin; and, taking advantage of the "grandes marées" of that month, I investigated very closely the extensive coral-reefs on the western side of the beautiful little island called Curieuse. My plan was to commence work about two hours before low water. Sending a small pirogue to row beside the water-edge of the reef, which here encircles the land, I used to walk along this edge, attended by Edouard, the captain of my black crew. His duty was to carry glass jars, into which to put my captures, and to help me in my encounters with eels and cuttle-fish; while by the aid of the pirogue I could cross over the deep gullies which very frequently occurred in the coral-reef, without the necessity of having to go to the shore so as to get round them. I need scarcely say that even when wading to my waist in the tepid waters, and half a mile from the shore, I could see, when the sea was tranquil, the surface of the reef as distinctly as if it were only covered by an inch or two of water. I had walked over this and other coral-reefs so very often, that I had not on this occasion much hope of discovering anything new. The surface on which I walked was a perfect carpet of a pretty bluish-green Xenia, interspersed here and there with patches of a bright scarlet and of a green alga. Sometimes, when a small heap of dead coral was met with and turned over, a large cuttle-fish would endeavour, and sometimes successfully, to get over the edge of the reef, and then away. Large specimens of that fine Holothuroid, Mülleria nobilis, and at intervals a Culcita, would be seen and collected. The edges of the gullies actually bristled with the long spines of Diadema savignyi. The pain caused by incautiously touching the spines of the species of this genus is very great, so great that I have had my arm and hand quite benumbed by it for some hours. At one spot, near the very edge of deep water, my foot sank in some soft yet brittle stuff, and, from the sensation, I knew I had crushed some coral structure that I had not before met with. On examination, this proved to be a mass of the Tubipora, which was growing parasitically on a large rock of madrepore; and now that I found the habitat of this species, I had no difficulty in finding any quantity of it. Some masses were two feet in diameter; but it more usually occurred in irregular lumps of about twelve inches in circumference, and from two to four inches in height. Very frequently it was covered over with tufts of a small green confervoid alga, or of some sessile halichondroid sponge; and under such circumstances the red colour of the polypidom was, of course, not conspicuous. The crowns of tentacles, like so many stars, were of a greenish colour. Some few pieces were found elevated on a stalk, as if the budding of the original individual polypes had advanced for some time in an upward and then in an outward direction. The polypes were very sensitive, and quickly contracted themselves; nor were they, like the polypes of Xenia, at all quick to show themselves after they had been once alarmed.


THE ORGAN-PIPE CORAL (*Tubipora musica*).

"My residence at Mahé, after the discovery of the living animals of this coral, was too short to admit of my investigating their development; but a very casual examination showed that the tubes were made up of spicules coalesced together, which were formed free and distinct on the upper margin of the tube, and that the tentacles were also thickly covered over with minute pale-coloured spicules."


THE SEA PEN (*Pteroides spinosus*).

ORDER V.—PENNATULACEA.

This order contains the Sea Pens. The colony of polypes is here somewhat pen-shaped, the plume portion containing the polypes, the pen portion horny and generally imbedded in the sand. Not many species are natives of Britain, but Virgularia mirabilis is to be found on our shores, and the wonderful Umbellularia groenlandica has been dredged up from a great depth on the north coasts of Scotland and Ireland. Pennatula rubra is a British species, and the one we figure is found in the Mediterranean.

ORDER VI.—GORGONIACEA.

This order contains an immense number of forms, most usually rooted to marine rocks. The skeleton is generally flexible, horny, or with spicules; or sometimes there will be a hard and horny axis in alternating layers, and a spicule-bearing covering. The best known species in this family is probably the Red Coral of commerce (*Corallium rubrum*).

PRECIOUS CORAL (*Corallium rubrum*).

Without pausing to note the various authors who have given their attention to the structure of this fine natural production, we shall at once direct ours to the organisation of the animals and the construction of the coral, as described by M. Lacaze-Duthiers, one of the Professors at the Jardin des Plantes, of Paris, in a remarkable monograph, entitled "L'Histoire Naturelle du Corail." This learned naturalist was charged by the French Government, in 1860, with a mission, having for its object the study of the coral from its natural history point of view. His observations upon it are numerous and precise, and worthy of the successor of Peyssonel.

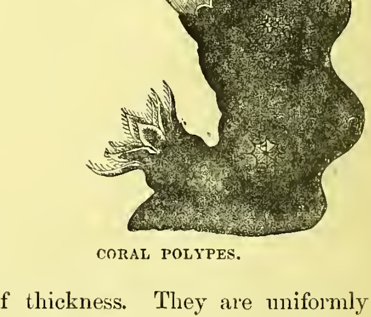
A branch of living coral, if we may use the term, is an aggregation of animals derived from a first being by budding. They are united among themselves by a common tissue, each seeming to enjoy a life of its own, though participating in a common object. The branch owes its origin to an egg, which produces a young animal, which attaches itself soon after its birth, and from this is derived the new beings which, by their united labours, produce the branch of coral or polypidom.

This branch is composed of two distinct parts; the one central, of a hard, brittle, and stony nature, the well-known coral of commerce; the other external, like the bark of a tree, soft and fleshy, and easily impressed with the nail. This is essentially the layer of the living colony. The first is called the polypidom, the second is the colony of polypes. Into this the polypes contract themselves when the water is withdrawn from the colony. It is covered with the retracted polypes.

Each protuberance represents a polype, and exhibits on its summit eight creases, radiating round a central pore, which presents a star-like appearance. This pore as it opens gives to the polypes an opportunity of coming out. Its edge presents a reddish calyx, like the rest of the bark, the festooned throat of which presents eight dentations.

The polype itself is formed of a whitish membranous tube, nearly cylindrical, having an upper disc, surrounded by its eight tentacula, bearing many delicate pinnæ spreading out laterally. This assemblage of tentacules almost resembles the corolla of some flowers; its form is constantly changing, but it always presents a very pretty appearance.

If the bark is examined more closely, three principal elements are recognised—a common general tissue, some spicula, and certain vessels. The general tissue is transparent, glossy, cellular, and contractile.



CORAL POLYPES.

The spicules are very small, calcareous bodies, more or less elongated, covered with knotted protuberances bristling with spines, and of a more or less regular determinate form. They refract the light very vividly, and their colour is that of the coral, but much less vivid, in consequence of their want of thickness. They are uniformly distributed throughout the bark, and give to the coral the fine colour which generally characterises it when in a living state.

Passing to the coral fishing, it may it be said to be quite special, presenting no analogy with any other fishing in the European seas, if we except the sponge fisheries. The fishing stations which occur are found on the Italian coast and the coast of Barbary; in short, in most parts of the Mediterranean basin.

The fishing is chiefly conducted by sailors from Genoa, Leghorn, and Naples, and it is so fatiguing that it is a common saying in Italy that a sailor obliged to go to the coral fishery should be a thief or an assassin. The saying is a gratuitous insult to the sailor, but conveys a good idea enough of the occupation.

The barks sent to the fishing range from six to fifteen tons; they are strong, and well adapted for the labour; their rig is a great lateen sail,. and a jib or staysail.

When the padrone thinks that he has reached a coral bank, he throws his engine overboard. As soon as the apparatus is fairly at the bottom the speed of the vessel is slacked; the capstan is manned by six or eight men, while the others guide the helm and trim the sails. Two forces are thus brought to act upon the lines, the horizontal action of the vessel and the vertical action of the capstan. In consequence of the many inequalities of the rocky bottom, the engine advances by jerks, the vessel yielding more or less, according to the concussion caused by the action of the capstan or sail. The engine seizes upon the rugged rocks at the bottom, and raises them to let them fall again. In this manner the swab floating about penetrates beneath the rocks where the coral is, and bring them home. It is a work of very great labour. The engine long resists the most energetic and repeated efforts of the crew, who, exposed half naked to the burning sun of the Mediterranean, work the capstan to which the cable and engine are attached, while the padrone urges and excites them to increased exertion; the sailors meanwhile trim the sails and sing with a slow and monotonous tone a song, the words of which improvise in a sort of psalmody the names of the saints most revered among the seafaring Italian population.

The lines are finally brought home, tearing or breaking blocks of rock, sometimes of enormous size, which are brought on board. The cross is now placed on the side of the vessel, the lines are arranged on the deck, and the crew occupy themselves in gathering the results of their labour. The coral is gathered together, and the branches of the precious Alcyonarian are cleansed and divested of the shells and other parasitic products which accompany them; finally, the produce is carried to, and sold in, the ports of Messina, Naples, Genoa, or Leghorn, where the workers in jewellery purchase them. Behold, fair reader, with what hard labour, fatigue, and peril, the elegant bijoutry with which you are decked is torn from the deepest bed of the ocean!

CLASS II.—HYDROZOA.

In the species belonging to this class the stomachal cavity is not separated from the general body cavity, as in the species of the previous class. Some of them are fresh-water forms, but the majority are, as in the class Actinozoa, marine. "Under this order," writes E. and A. Agassiz, "are included a number of groups which, whether as Hydroid communities in their earlier phases of existence, or as free-swimming Medusæ in their further development, challenge our admiration, both for their beauty of form and colour and their grace of motion. Some of them are so minute that they escape the observation of all but those who are laboriously seeking for the hidden treasures of the microscopic world; but the greater number are large enough to be readily found by the most inexperienced collector when his attention is once drawn to them; and he may easily stock his aquarium with these pretty little communities, and even trace the development of the jellyfishes upon them. To the Hydroids belong the Campanularians, the Sertularians, and the Tubularians. There is another group usually considered as distinct from Hydroids, and known as a separate order among Acalephs, under the name of Siphonophora, but included with them here in accordance with the views of Vogt, Agassiz, and others, in whose opinion they differ from the ordinary Hydroid communities only in being free and floating, instead of fixed to the ground." But for our purposes it will be better to include the Acalephs and Siphonophora in the class as follows:—

SUB-CLASS I.—HYDROIDA.

One of the commonest species of the first order of this sub-class (Eleutheroblastea, Allman) is the Common Fresh-water Hydra (*Hydra vulgaris*), to be found adhering to fresh-water plants. The Medusæ form a second order (GYMNOBLASTEA, Allman) in themselves; the polypes here unite to form colonies, which are rooted. Some of the polypes of a colony will be engaged in nutrition, and others in reproduction, and these will not be alike in form. From the sac-like forms in which the zooid forms are lodged will proceed the small, delicate, umbrella-shaped jelly fish so often to be seen floating and swimming in a quiet summer's sea. The Campanulariæ, or cup-shaped polypes (CALYPTOBLASTEA, Allman), form a third order. These are also colonial forms, but the polypes are lodged in bell-shaped receptacles. These, also, have lovely medusæ-like zooids.

All the Hydroids, with the exception of Hydra and a few other genera, are marine productions, varying in size from a few lines to upwards of a foot in height. The members of this sub-class are found attaching themselves to rocks, shells, seaweeds, and corallines, and to various species of crustacea. Many of them attach themselves indiscriminately to the nearest object, but others show a preference for some special substance. Thuiaria thua attaches itself to old bivalves; Thoa halecinia prefers the larger univalves; Antennularia antennina attaches itself to coarse sand or rocks; Laomedea geniculata delights in the broad fronds of the tangle; Plumularia catherina attaches itself in deep water to old shells, corallines, and ascidians, growing in a manner calculated to puzzle naturalists, as it did Crabbe, the poet, who writes of it :—

> "Involved in sea-wrack, here you find a race
> Which Science, doubting, knows not where to place;
> On shell or stone is dropp'd the embryo seed,
> And quickly vegetates a vital breed."

HYDRA VULGARIS.

The Sertularians have a horny stem, sometimes simple, sometimes so branching that they might readily enough be mistaken for small plants, their branches being flexible, semi-transparent, and yellow. Their name is derived from sertum, a bouquet. Each Sertularian may have seven, eight, twelve, or twenty small panicles, each containing as many as 500 polypes; thus forming, sometimes, an association of 10,000 polypes. "Each plume," says Mr. Lister, in reference to a specimen of Plumularia cristata, "might comprise from 400 to 500 polypes;" "and a specimen of no unusual size now before me," says Dr. Johnston, "with certainly not fewer cells on each than the larger number mentioned, thus gives 6,000 as the tenantry of a single polypidom, and this on a small species." Of Sertularia argentea it is asserted that masses are found on which there exist not less than 80,000 to 100,000 polypes.

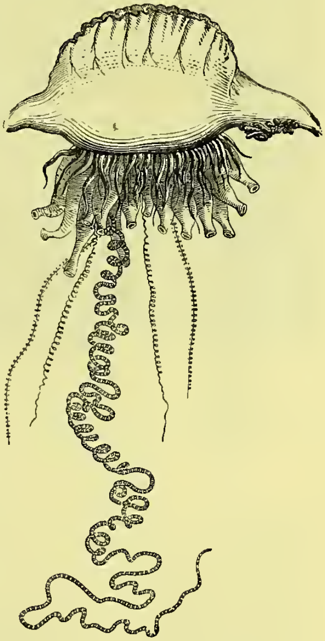
In a fourth order (MILLEPORIDA), since the researches of Agassiz and Moseley, the massive corals known as Millepores, which abound on the edges of coral reefs in the tropical seas, must be placed.

SUB-CLASS II.—SIPHONOPHORA.

This contains some free ocean-swimming polypes, grouped in colonies. Part of the axis sometimes acts the part of a float, to suspend the polype mass, and at other times some of the laterally placed polypes will become altered into swimming-bells, which carry the rest of the mass about. To this sub-class belong some beauteous forms, forming the orders—1. CALYCOPHORIDA, in which the colony is propelled by swimming-bells, and of which Praya diphyes may serve as a type. 2. PHYSOPHORIDA, in which the colony, in addition to the swimming-bells, has a float, well seen in Physophora hydrostatica; where, also, are well seen the wonderful filaments used by the colony as fishing-lines, and furnished with stinging cells, ready to discharge their barbed contents. The Portuguese Man-of-War (*Physalia utriculus*), the stinging filaments of which can cause such irritation to the human skin, also belongs to this order.

Leblond, in his "Voyage aux Antilles," relates as follows :—One day I was bathing with some friends in a bay in front of the house where I dwelt. While my friends fished for sardines for breakfast, I amused myself by diving, in the manner of the native Caribbeans, under the wave about to break. Having reached the other side of one great wave, I had gained the open sea and was returning on the top of the next wave towards the shore. My rashness nearly cost me my life. A Physalia, many of which were stranded upon the beach, fixed itself upon my left shoulder at the moment the wave landed me on the beach. I promptly detached it, but many of its filaments remained glued to my skin, and the pain I immediately experienced was so intense that I nearly fainted. I seized an oil-flask which was at hand, and swallowed one half, while I rubbed my arm with the other. This restored me to myself, and I returned to the house, where two hours of repose relieved the pain, which disappeared altogether during the night."

Mr. Bennett, who accompanied the exploring expedition under Admiral Fitzroy, as naturalist, ventured to test the powers of the Physalia. "On one occasion," he says, "I tried the experiment of its stinging powers upon myself, intentionally. When I seized it by the bladder portion, it raised the long cables by muscular contraction of the bands situated at the base of the feelers, and entwining the slender appendages about my hand and finger, inflicting severe and peculiarly pungent pain It adhered most tenaciously at the same time, so as to be extremely difficult of removal. The stinging continued during the whole time that the minutest portion of the tentacula remained adherent to the skin. I soon found that the effects were not confined to the acute pungency inflicted, but produced a great degree of constitutional irritation. The pain extended upwards along the arm, increasing not only in extent but in severity, apparently acting along the course of the absorbents, and could only be compared to a severe rheumatic attack. The pulse was accelerated, and a feverish state of the whole system produced; the muscles of the chest, even, were affected, the same distressing pain being felt on taking a full respiration as obtains in a case of acute rheumatism. The secondary effects were very severe, continuing for nearly three-quarters of an hour; the duration being probably longer in consequence of the time and delay occasioned by removing the tentacula from the skin, to which they adhered by the aid of the stinging capsules, with an annoying degree of tenacity. On the whole being removed, the pain began to abate, but during the day a peculiar numbness was felt, accompanied by an increased temperature in the limb on which the sting had been inflicted. For some hours afterwards, the skin displayed white elevations, or weals, on the parts stung, similar to those resulting from the poison of the stinging-nettle. The intensity of the pain depends in some degree upon the size and consequent power of the creature. After it has been removed from the water for some time, the stinging property, although still continuing to act, is found to have perceptibly diminished. I have observed, also, that this irritative power is retained for some weeks after the death of the animal in the vesicles of the cables, and even linen cloth which has been used for wiping off the adhering tentacles, when touched, still retained the pungency, although it had not the power of producing such violent constitutional irritation."



PHYSALIA UTRICULUS.

SUB-CLASS III.—CALYCOZOA.

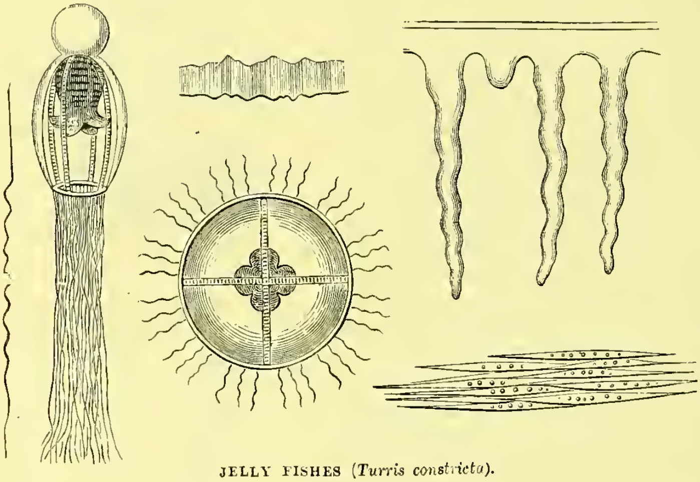
This sub-class is formed to receive a few pretty marine stalked forms, several of which are natives of Britain, and all of which can be placed in the one family (Lucernaridæ). They have soft, radiate bodies, bell-shaped, ending in a disc, by which they attach themselves to sea-weeds. The margin of the bell carries the clusters of short tentacles. The mouth is in the centre of the bell, surrounded by the tentacles. One species (*Lucernaria auricula*) is common in all suitable localities around our coasts.

SUB-CLASS IV.—DISCOPHORA.

This sub-class contains a number of free ocean-swimming forms, mostly known as jelly fish, often growing to a very large size. In the first order (RHIZOSTOMIDA) the tentacles hang down like a bundle of twigs from the under central portion of the umbrella-shaped mass, as is well seen in Rhizostoma cuvierii, a beautiful species often to be found in great numbers cast ashore on the south coasts of England and Ireland. In the second order (PELAGIADA) the tentacles are placed all around the margin of the umbrella. The mouth is central. The accompanying figure will give some notion of these fragile forms. They are rarely solitary, but seem to wander about in considerable battalions in the latitudes to which they belong. During their journey they proceed forward with a course slightly oblique to the convex part of their body. If an obstacle arrests them, if any enemy touches them, the umbrella contracts and is diminished in volume, the tentacles are folded up, and the timid animal descends into the depths of the ocean.

In respect to size the species vary immensely. Some are very small, while others attain more than a yard in diameter. Many species are phosphorescent during the night.

Most of them produce an acute pain when they touch the human body. The painful sensation produced by this contact is so general in this group of animals, that until very recently all the animals of the group have been, after Cuvier, designated under the name of Acalephæ or sea nettles, in order to remind us that the sensation produced is analogous to that occasioned by contact with the stinging leaves of the nettle.


JELLY FISHES (*Turris constricta*).

According to Dicquemare, who made experiments on himself in this matter, the sensation produced is very like that occasioned by a nettle, but is more violent, and endures for half an hour. "In the last moments," says the Abbé, "the sensation is such as would be produced by reiterated but very weak prickings. A considerable pain pervaded all the parts which had been touched, accompanied by pustules of a reddish colour with a whitish point."

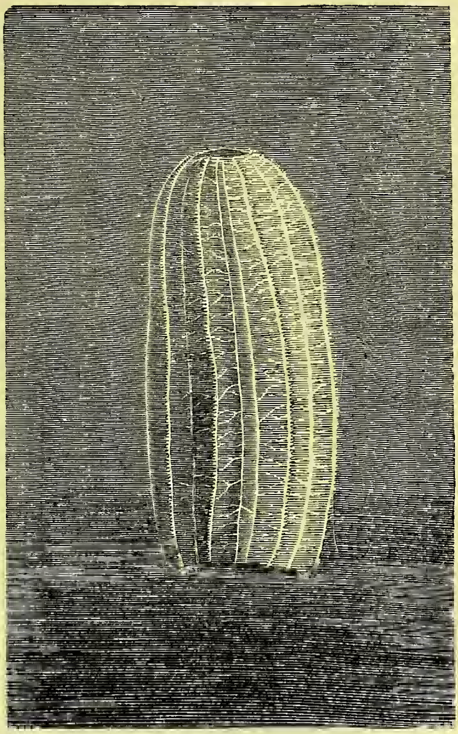
SUB-CLASS V.—CTENOPHORA.

In this sub-class we find a number of quite transparent, free-swimming, oceanic forms. They form an exception in the class, in having cilia over or in spots upon their outer integument. These are often placed in little comb-like rows, from whence the name of the sub-class, upon the delicate bodies. Some of them have hollow retractile tentacles; most of them are oval in shape, or like tiny glass beads; some few have the body ribbon-like, and one not uncommon Mediterranean species is known as Venus' Girdle, from its peculiar shape (*Cestum veneris*). We give a figure of Beroe forskalii.

Mr. Patterson thus writes of a well-known Irish species:—"A species larger than the Cydippe, and different in form, is also generally diffused round our coast. Its occurrence is more rare, yet it sometimes appears in such abundance that, in Bangor Bay, Co. Down, we took on one occasion one hundred and thirty of them in twenty-five minutes. Its body is more fragile, its movements less active, and it is furnished with four ear-like appendages, which are ever changing in their form. When the water in which it is kept is shaken at night or in a dark place, splendid coruscations of a beautiful greenish light are emitted, especially under the several bands of cilia. On one occasion we placed some specimens of this species (Bolina hibernica) in a jar on the chimney-piece, and so transparent were the bodies that the blossoms of some flowers which were also there were distinctly seen through them. It was impossible to look upon these bright-tinted blossoms of earth, and on those colourless, yet not less delicate, children of ocean, and not feel that both must have enjoyed the guardianship of Him from whom all their loveliness was derived; that He who had for ages preserved the flowers from perishing by frost, or wind, or rain, had likewise saved the Beroës from destruction amid the wild tempests of the ocean."

The power just adverted to, of emitting a beautiful phosphorescent light, is so remarkable in some of the large medusæ, that they have been compared to balls of fire suspended in the water.

To those who delight in the contemplation of such phenomena it affords wondrous pleasure to observe from a boat, on a calm night, the effulgence which these creatures shed over the surface of the sea. It is impossible at such times not to be reminded of the beautiful lines of Coleridge:—



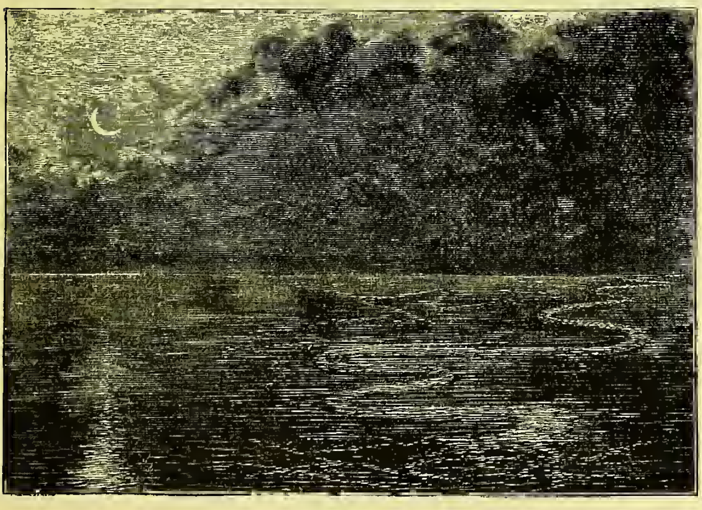
BEROE FÖRSKALII.

"Beyond the shadow of the ship
I watched the water-snakes:
They moved in tracks of shining white,
And when they reared, the elfish light
Fell off in hoary flakes.

"Within the shadow of the ship
I watched their rich attire:
Blue, glossy green, and velvet-black;
They coiled and swam, and every track
Was a flash of golden fire.

"Oh, happy living things! no tongue
Their beauty shall declare:
A spring of love gushed from my heart,
And I blessed them unaware."

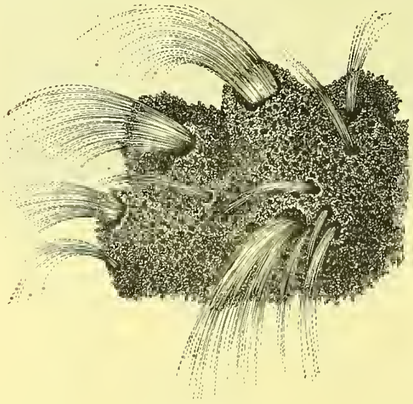
Of the multitudes of medusæ occasionally seen by voyagers we have various accounts. Professor Piazzi Smyth, in a charming volume, entitled "Teneriffe: an Astronomer's Experiment," speaks of having passed through "an enormous shoal" of them, and adds, "The least diameter we could assign to the collection was thirty or forty square miles; and at the rate of one to every ten square feet of surface, which seemed to be a very moderate estimate, there must have been some 225,000,000 of them even in the surface stratum." Maury



PHOSPHORESCENCE ON THE SEA.

was informed by an intelligent sea-captain that in the Gulf Stream, on the coast of Florida, he fell in with such a "school of young sea-nettles as had never before been heard of. He was bound to England, and was five or six days in sailing through them." But this abundance of animal life is not restricted to the tepid waters of the Gulf Stream: we learn from Scoresby that it is not less manifest in the Northern Seas. On examining a bucket of the olive-green water of the Greenland Sea, he found its peculiar colour was owing to the multitude of minute medusæ which it contained. "They were about the one-fourth of an inch asunder. In this proportion a cubic inch of water must contain 64; a cubic foot, 110,592; a cubic fathom, 23,887,878; and a cubical mile, 23,888,000,000,000,000!" Provided the depth to which they extend be but 250 fathoms, the above immense number of one species may occur in a space of two miles square. It may give a better conception of the amount of medusæ in this extent if we calculate the length of time that would be requisite, with a certain number of persons, for counting this number. Allowing that one person could count a million in seven days, which is barely possible, it would have required that 80,000 persons could have started at the creation of the world to complete the enumeration at the present time.

CLASS III.—PORIFERA, OR SPONGES.

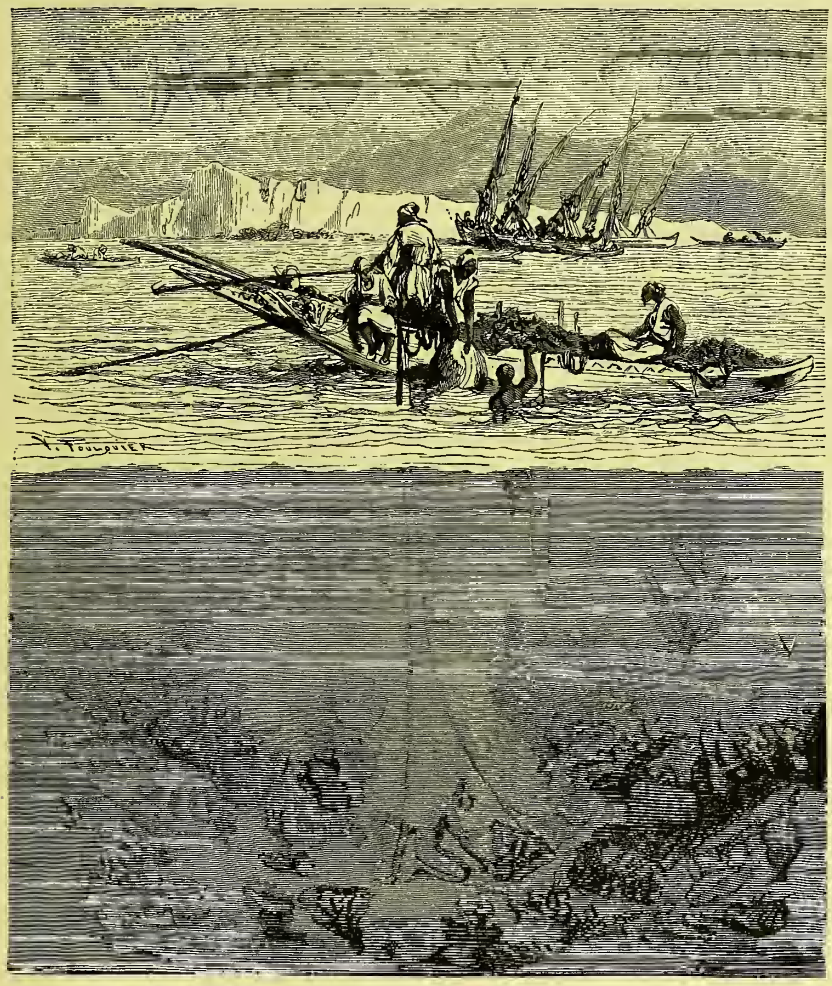


SPONGE OSCULES.

THE sponges are by many placed here as a class; and by others they are regarded as belonging to the next sub-kingdom. The sponges are all aquatic, most of them living in salt water. They receive their name from having many apertures, instead of, as in all the animals which we have up to this examined, one entrance into their body cavity. Their bodies may be regarded as made up of so many independent masses of animal protoplasm, which arrange themselves in two layers, and are so grouped as to leave a common central cavity, into which open the pores, and from which then opens one or more large mouth-like orifices (oscula).

It is interesting to note the progress made in our knowledge of this sub-class. Pliny's account of sponges is entirely borrowed from Aristotle, and he also puts them among those productions "that have a third or middle nature, and are neither living creatures nor yet plants." In a subsequent chapter, however, wherein is enumerated at length their various economical and medicinal applications, he has apparently forgotten their "middle nature," and declares that he had before proved the sponges to have life, "yea, and a sensible life," "for their is found of their bloud settled within them" And, as it were, to strengthen this opinion, he adds, "Some writers report that they have the sense of hearing, which directs them to draw in their bodies at any sound or noise made, and therewith to squeeze out plenty of water which they contained within; neither can they easily be pulled from their rocks, and therefore must be cut away; whereby they are seen to shed a deale of bloud, or that which resembleth bloud very neer." Pliny further informs us that some writers distinguish sponges into male and female, "for some of them they have thought to be of the male sex, to wit, those which have smaller pipes or concavities, and those growing thicker and more compact, whereby they suck up more moisture; and these, our delicate and dainty people die in colours, and otherwhile give them a purple tincture. Others they count of the female sex, namely, such as have bigger pipes, and the same running throughout one continuity without interruption. Of the male kind, some may be harder than others, which they call Tragos; the pipes whereof are the finest, and stand thickest together."

It thus appears that sponges were the first of the Zoophytes to have their animality asserted, a fact sufficiently remarkable, seeing that in their fixedness, their unsymmetrical shapes, their texture and defect of all defined organs, and their insensibleness, they exhibit the very evidence which would naturally force us to a contrary conclusion. And these evidences, from outward show and appearances, soon proved their influence, for when, after the revival of letters and science, natural history began to be studied anew, sponges were uniformly classed and described as members of the vegetable kingdom, being reckoned among the most imperfect productions of their class; and in accordance with the theories of the period, their generation was attributed to a fermentation of the sea's scum, or its spontaneous pullulations. "There is found," says Gerard, "growing upon the rockes neere unto the sea, a certaine matter wrought together, of the fome or froth of the sea, which we call spunges." It is true that the notion of their animal nature was not allowed entirely to die away, for every successive compiler retailed the relations of Aristotle and Pliny, but no one was thence induced to remove the subjects of them to the animal kingdom. Thus Ferrante Imperato, who is said to have had suspicions of the animality of other Zoophytes, unhesitatingly describes the sponges among cryptogamous vegetables, and expresses his opinion that, in their structure, they were nearly allied to the Fungi. His short preface to the description of the Neapolitan species contains a condensed view of what he found in Aristotle, with whom he agrees in attributing to the sponges in general a power of alternate contraction and dilation when under the influence of some painful irritation; but he believes the contractile medium to be the mucilaginous fluid that fills up the interstices of the sponge.



DIVING FOR SPONGES.

Ray rejects what the ancients have said of the life and sensation of the sponge, of its spontaneous movements or contractility, and of its food and nourishment, as being partly unproved and suspicious, and partly as false, for who, he asks, can believe, on the sole argument of small shells having been found in them, that sponges can feed on shells or on fish? He would rather believe that the shell-fish had crept into their pores and holes for shelter, or for the purpose of feeding on the sponge. The statement of this shrinking under the divers' hand he considers to be equally incredible, but naturally enough explains the origin of the story from what we know of the inherent elasticity of the productions in question. He agrees with Imperato in considering them, as of all marine vegetables, the most nearly related to the Fungi, being composed of a substance like compacted wool, perforated with tubes and holes, and covered over with a certain membranaceous mucilage. The sponges live affixed by a root to rocks, shells, and in sand; if torn away they shoot up again from their root and grow as other plants do. Their peculiar property is to be easily compressed, and then again to swell out to their pristine bulk, hence the facility with which they imbibe any fluid and allow it to flow out on the application of convenient pressure (Dr. Johnston).

No very settled classification of sponges as yet exists. Some have a horny fibrous skeleton, so well known to us in our toilet sponges, an account of the taking of which latter we borrow from Captain Spratt's "Travels in Crete":—

"The east coast of Crete is noted for the quantity and very fine quality of the sponges which grow in its waters, and it is in consequence annually frequented by from fifty to one hundred boats, with seven or eight sponge-divers in each, who are chiefly from the islands of Calymus, or Khalki; and they frequently visited the north-east coast during our stay there, Symi, and excited much interest among us in their occupation. Of the many varied ways by which man labours to procure his bread, there is none perhaps so interesting and extraordinary as that of the sponge-diver; and when the luxurious fair use the sponge at their toilet, or the gentleman at his morning ablutions and bath, little do they know or think of the hard and peculiar trials and exertions some fellow-creature has gone through before he was enabled to procure for their gratification this valuable and peculiar marine production. And as little, perhaps, have they ever troubled themselves with the discussions that have arisen among philosophers, since the days of Aristotle, as to whether the sponge is an animal or a vegetable. Its now well-ascertained but fitful circulation of the sea-water through its pores seems at length to have led many savants of natural history to conclude that it really is an animal. Yet this fact is all that can be advanced, viz., that it has a spasmodic inspiration and rejection of sea-water; and, except being covered with a slimy, viscous coating, of a bluish-black colour above, and dirty white beneath, the sponge is the same shape and size when cleansed and fit for use as when living, the mode of cleansing it being simply to squeeze and wash the sponge two or three times in the sea and dry it in the sun for a few hours, until all gelatinous matter is extracted from it.

"When a reflective mood comes over a man as he sits enjoying the sight of his parlour fire, he is apt to think then of the means by which the coal he sees sparkling in the grate is procured from the recesses of the earth, and he shudders, perhaps, as he thinks of the thousands who are at that moment labouring in the bowels of the earth, from 1,000 to 2,000 feet below the surface, in the midst of darkness, dirt, and danger. But when he handles the soft sponge that so gratefully moistens his body, he has no conception of the hardships and dangers that beset the man that procured it for him from the depths of the sea, in all probability between 100 and 200 feet below its surface, and by actually diving for it! Marvellous as it may appear, yet such is the fact, that man's power of versatility is so great that he can be brought to endure suspended respiration and to sustain the pressures experienced during a dive to depths of twenty or thirty fathoms; nay, I have been assured that in some few instances he has been known to reach forty fathoms without the aid of any diving apparatus, save a flat stone carried in his hands to facilitate his descent. I have myself known many instances of divers going down to depths of from twenty to thirty fathoms; and I knew a family of three brothers, belonging to the island of Symi, who were called by their compatriots (and known to all the sponge-diving fraternity as) the Sarandaki, or the Forties, from their reputed capability of diving to that enormous depth. They were known to me more than twenty years ago, and for several years after; but only one of the three survives, and he is now employed in the arsenal at Constantinople as the Government diver. One of the other two lost his life whilst diving off the coast of Syria, either by a fit of apoplexy or by a fish, as the body was never recovered. Now it is evident that nothing but a most severe training from a very early age, and the possession of great powers of endurance as well as courage, could enable any one to perform feats so extraordinary as this; and when it is considered that at the depth of twenty fathoms the pressure of the water upon the body is 50 lbs. to the square inch, and at thirty fathoms 75 lbs., or about that of five atmospheres, and thus at every dive to those depths the body passes through these great pressures with inflated lungs, and in scarcely more than the time that it takes to write the fact, the full extent of the trial to the lungs, heart, and mental powers of the diver to maintain self-possession and suspended respiration, can be better appreciated, and the marvellousness of the feat becomes the more striking. I have in many instances timed the diver's stay under water, and found it to range from 90 to 120 seconds, and have no doubt that the most enduring diver could stay from 10 to 20 seconds longer; for when diving in the greater depths, and sponges are plentiful, they often remain, under the excitement of work and the prospect of profit, until they feel the sensations of drowning commence, or, as they express it, until they feel that they are 'falling asleep.'

"The sponge is known to have been an article of commerce in the days of Aristotle, and probably long before, for it was used by the ancients in their helmets and boots as a cushion and absorbent of the moisture from the head and feet. Thus there must have been sponge-divers then; for Aristotle relates that the finest sponges came only from the greater depths, and accounts for it from the temperature remaining more constant there, a very interesting evidence of the knowledge of this great philosopher; for the range, permanency, and fluctuation of temperature in the depths of the sea is comparatively a very modern subject of inquiry; yet this great philosopher and master mind had in some degree understood it. And it is, I think, an evidence of the great depth to which the divers then went for the sponge, as now, because it was from them that he learned the fact. They were the thermometers that told it, from the sensations experienced by their bodies when diving in those depths.

"The temperature of the Mediterranean basins have a speciality or peculiarity in their conditions, from the insulated or detached character of the basins themselves. Thus, I have found that below 100 fathoms the temperature is nearly always permanent, and stands at about (or perhaps a little above) the average annual atmospheric temperature of the locality, namely, from 54° to 58°, according to the part, and that it is between fifty fathoms and the surface that the temperature is most variable. This the diver's experience would enable him to describe, without reference to any comparative quantity or standard measure; for the length of the diver's stay under water, and the depths he can go, greatly depend upon the temperature of the water.

"But I am disposed to give a different or another reason, besides permanency of temperature, for the deeper waters being the most favourable for the growth of the finer sponges. I think it also arises from the greater tranquillity and clearness of the water, as much as from the more permanent temperature of those depths; for their natural habitat seems to be where there is a firm basis, such as a rock, to attach themselves to, and where little mud or sand exists to render the water impure and turbid under the agitation of storms and currents. It may surprise the reader to be informed that the quantity of fine sand he finds in a new sponge has not been enclosed there by the animal or vegetable during its growth, but is an adulteration practised by the agents and merchants who purchase the sponge from the divers, in order to increase its weight and their profit. I have seen, in the islands of Symi, Calymna, and Khalki, as well as elsewhere, the recently-arrived cargoes of several sponge-boats undergoing the process of adulteration before packing. The sand having been imported from some spot known to yield it of the fineness requisite for the purpose, is mixed with water, in which there is a little gelatine or gum, to enable the sponges to take up and retain it the better, and without being detectable afterwards. The sponges are then well kneaded into it, so as to fill up their minute pores; they are then dried in the sun, and packed very closely together in goat's-hair sacks, of an open texture, that the sand, as it becomes detached from the sponges by the motion of their transit, may escape, and prevent detection by the European trader.

"In this way, a hundredweight of sponges in their dry state will be so sanded as to weigh more than a ton, before they are packed for exportation to Europe. The local merchants understand the process, and charge accordingly; and thus they have hitherto derived the chief profit, whilst the poor diver hardly obtains more than a scanty living for all his risks and hardships, and is in general in debt to the local trader; for, being idle all the winter, through having no other occupation, he is, in consequence, too frequently brought into the power of the local trader as a money-lender, and, through habits of drunkenness and gambling following upon idleness, becomes his perpetual debtor. The sponge-fishers are thus a degraded class of the Greek community, and chiefly belong to those islands where there is no produce or trade—barren rocks in comparison to the generality, but comparatively healthy localities—and, as they are there almost free from the Turkish rule, they are more independent than in the larger islands or the towns on the coast of Asia Minor. This comparative liberty induces them to prefer their native rock to another; and necessity obliges them to seek their bread from the sea, as the island is incapable of affording it. Hence, they seem to have followed the occupation of sponge-divers from generation to generation for many centuries.

"A visit to the ports of one of these islands presents, at certain seasons, an interesting scene of the aquatic gambols of the young divers, who, from two to ten years of age, sport in the sea as if it were their natural element; for, in the summer months, when the grown-up are all absent, and the children and aged only left, the mothers seem to send their infants to the water as soon as they can walk, as a duck does her brood, and they are very soon expert enough to dive in two, three, and five fathoms.

"At the first commencement of the diving-season, the diver suffers much, and cannot easily dive at greater depths than twelve and fifteen fathoms for a few days; the eyes, nose, and ears then bleed freely under the pressure, and consequent congestion of the vessels.

"The sponge-fishing is chiefly carried on in neatly-rigged but small caïques, or half-decked boats, from eight to ten tons' burthen, that contain from seven to nine men in each, and fine models, that seem to have been the original of the famed yacht, the *America.* They go to work in companies of half a dozen to twenty or thirty boats, for mutual support and protection; and when the weather is favourable, and they are in working condition, each diver will dive fifteen and even twenty times a day, in as many fathoms.

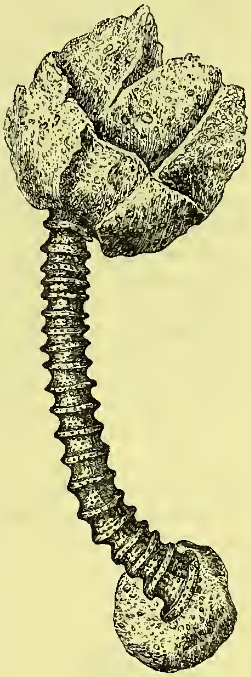
"They are obliged to be particular in their diet during the diving season, making no meal until evening, and sustaining their strength by an occasional pipe and a small cup of coffee once or twice during the day.

"It is to behold one of the most interesting sights possible to be in the midst of a fleet of these sponge-boats when the men are at work on their fishing-ground; for they are like a flight of mosquitoes, or, rather, of butterflies flitting from flower to flower, as they move from one spot to another, anchoring for a few minutes only whilst a few dives are made, then hoisting their numerous and well-handled sails to shift a few yards farther in the direction desired, and then anchoring again and diving, as long as the weather is favourable and sponges are procurable. The same ground is thus often worked over and over year after year; but they say that a rest of two or three years is necessary to ensure a good crop of full-grown sponges upon the same spot.

"In a few minutes the whole party were actively diving there; and the ground being new to them they made a great harvest in a few hours. Being exposed so much in the sun whilst diving, they look, when stripped, a different race of men from the Greeks in general, in consequence of the bright copper-colour of their skins, and their lean figures. The mode of operation preparatory to a dive is very peculiar and interesting; the sketch in some degree represents this also. The diver whose turn it is takes his seat on the deck of the vessel, at either the bow or stern, and, placing by his side a large flat slab of marble, weighing about 25 lbs., to which is attached a rope of the proper length and thickness ($1\frac{1}{2}$ in.), he then strips, and is left by his companions to prepare himself. This seems to consist in devoting a certain time to clearing the passages of his lungs by expectoration, and highly inflating them afterwards, thus oxidising his blood very highly by a repetition of deep inspirations. The operation lasts from five to ten minutes or more, according to the depth; and during it the operator is never interfered with by his companions, and seldom speaks or is spoken to; he is simply watched by two of them, but at a little distance, and they never venture to urge him or to distract him in any way during the process. It seems to a spectator as if the diver were going through a sort of mysterious ceremony or incantation. When, from some sensation known only to himself, after these repeated long-drawn and heavy inspirations, he deems the fitting moment to have arrived, he seizes the slab of marble, and after crossing himself and uttering a prayer, plunges with it like a returning dolphin into the sea, and rapidly descends. The stone is always held during the descent directly in front of the head, at arm's length, and so as to offer as little resistance as possible; and by varying its inclination, it acts likewise as a rudder, causing the descent to be more or less vertical, as desired by the diver.

"As soon as he reaches the bottom, he places the stone under his arm to keep himself down, and then walks about upon the rock, or crawls under its ledges, stuffing the sponges into a netted bag with a hooped mouth, which is strung round his neck to receive them; but he holds firmly to the stone or rope all the while, as his safeguard for returning and for making the known signal at the time he desires it.

"Now let us notice the proceedings of his companions in the boat floating some twenty or thirty fathoms above him. The two men who were nearest to him previously to his making the dive, but who systematically seem to place themselves so as to prevent him from conceiving the idea of being impatiently watched by them whilst undergoing the preparation, spring to their feet as soon as he disappears, and rush to the rope, which one of them then holds in his hand, veering it out or shortening it in as the diver moves about upon the bottom; and as soon as the signal indicative of his wish to return is felt, they commence hauling up the rope with great energy and earnestness, and in a way calculated to ensure the greatest expedition of ascent, since the over-stay of a few seconds may be a point of life or death to the diver. The hauling up is thus effected:—The assistant who has a hold of the rope, with a great bodily effort raises it up to nearly arm's length over his head; the second assistant is then prepared to make his grasp as low down as he can reach, and does the same; and so on the two alternately, and, by a fathom or more at a time and with great rapidity, bring the anxious diver to the surface. A heavy blow from his nostrils, to expel the water and exhausted air, indicates to his comrades that he is conscious and breathes. A word or two is then spoken by his companions to encourage him, if he seems much distressed, as is often the case, and the hearing of the voice is said by them to be a great support at the moment of their greatest state of exhaustion. A few seconds' rest at the surface, and then the diver returns into the boat to recover, generally putting on an under garment, or jacket, to assist the restoration of the animal heat he has lost, and to prevent the loss of more by the too rapid evaporation of the water from his body. Such is the trying life of a Levantine sponge-diver; and doubtless there are very few of us who have any idea of what a fellow-creature has suffered in procuring that little article which has become a necessity of our toilet-table, and the luxury of our mornings' ablutions.



KALISPONGIA ARCHERI.

"The number of sponge-divers, who depend on it for a livelihood, is probably about 3,000 in all, almost all of them inhabitants of the five or six south-eastern islands of the Archipelago, viz., Symi, Rhodes, Khalki, Tilo, Kalymnas, and Astropalea. There are a few, also, at Lero and Castelorizzo: but they chiefly belong to the most barren of these two islands. It is curious that there are none in the neighbouring islands of Carpatho and Caso; and although the former is a singularly-formed and comparatively barren island, the male population are all house-builders and masons, not sailors, and consequently pass the summer season in various localities, far and near, building and repairing houses; whilst the inhabitants of the still more barren island of Caso, between it and Crete, are all ship-builders and sailors, none sponge-divers, and, next to those of Syra, build the greatest number and the finest of the ships used by the Greeks."

One pretty little fibrous form, which is, perhaps, amongst the tiniest of this group, we give a figure of. It (*Kalispongia archeri*) has been found growing on sea-weeds from Australia. Some sponges have siliceous spicules mixed up with the horny fibres; and among this group has been found such magnificent forms as Venus's Flower-basket (*Euplectella aspergillum*), and others allied to it. Some have chalky spicules, and many of these are very common around our coasts, living attached to sea-weeds. Very few species of this sub-class are in their adult forms otherwise than attached.

SUB-KINGDOM VII.—PROTOZOA.

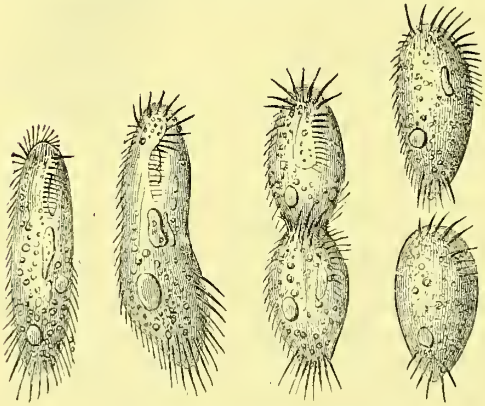
We have but little space to record the chief characteristic features of this, the last and the lowest of the sub-kingdoms. It consists of an immense number of very minute beings, each one of which is made up of a more or less tiny speck of animal protoplasm. Often this protoplasm is to be seen in an almost undifferentiated condition—a small blob of a viscid, colourless, unstable albuminoid, able to contract itself, and also to add to itself by assimilating other carbon compounds. The chemist has not yet taught us how to distinguish between this protoplasm as found in the lowest plants and in the lowest members of this sub-kingdom; but in the plant protoplasm the tendency is for the protoplasm to enclose itself by a cellulose cell wall, and no mass of vegetable protoplasm can long exist in a living state without this formation of cellulose, which is a combination of the elementary bodies known as carbon, hydrogen, and oxygen ($C_6 H_{10} O_5$), whereas this substance is scarcely ever to be met with in the animal kingdom, and has never been met with in this sub-kingdom.

It need scarcely be said that no nervous system, no blood system, and, what is more strange, no very special alimentary system, is to be found among these lowly forms. Amidst their protoplasmic bodies there will be met with sometimes a denser part called a nucleus; sometimes a clear and contractile portion, known as the contractile vesicle; now and then a few fine granules. When locomotive they move by prolongations of their soft bodies, called pseudopods (false feet), or by eyelash-like prolongations, called cilia. Of very many of them the life history is unknown; but very great has been our advance in a knowledge of them within the last few years.

It is probably owing to our ignorance of many of the forms that there are such difficulties as to how to arrange them into classes and orders. Some of the forms seem to have affinities with the sponges, some with the lowest of the worms. We may here divide the sub-kingdom into the following classes:—

CLASS I.—INFUSORIA.

The species forming this class are, even the very largest, such as Stentor, scarcely visible to the sharpest human eye, and many of them are below the 2,500th of an inch in diameter. They are still among the highest forms of the Protozoa, and are usually provided with an oral region, in which is at least the commencement of an alimentary system. Some few even possess a few scattered masses of pigment, which may serve the purposes of eye-dots. Some of them are free, and to be found swimming in both fresh and salt water. Others are attached in their adult state by stalks, and these are sometimes highly elastic. Some few of these Infusoria unite into colonies. They are reproduced by means of one individual dividing into two, by a process of gemmation, or by a process known as conjugation. For convenience, we place here the Infusoria with long whip-like projections of their protoplasm, known as the Flagellata, among which the well-known phosphorescent Noctiluca will be found, and the ciliated forms called Ciliata by some, and generally regarded as the true Infusoria.



STYLONYCHIA LANCEOLATA.

CLASS II.—RHIZOPODA.

Most of the organisms in this class, as Professor Allman well puts it in an able review of recent researches among these protoplasmic organisms, have probably their nearest relations with animals rather than with plants; but it must not be forgotten that the distinction is in many cases arbitrary, and that we have often no reliable character which will enable us to assert that the scarcely differentiated particle of protoplasm before us belongs to the animal kingdom rather than to the vegetable, or to the vegetable rather than to the animal.

In morphological value none of them pass beyond the stage of a simple cell, or, at most, of two or more cells fused together into a single protoplasm mass, without any tendency to the formation of tissues or the differentiation of organs. In the protoplasm, however, may frequently be distinguished two layers or zones—an external layer (ectosarc), clearer and more homogeneous; and an internal layer (endosarc), less transparent and more loaded with granules. These two layers, for the most part, pass gradually into one another.

Hertwig and Lesser have distinguished in these organisms two kinds of locomotion. In one the contractility of the protoplasm affects equally the whole mass; the body changes but slightly its contour, and glides over the supporting object by a constant rotation of its whole surface, as is seen in Hyalodiscus (Hertwig and Lesser). In the other, which is by far the more frequent condition, locomotion is effected by the contractility of limited portions of the surface, either causing the protrusion and retraction of blunt or pointed pseudopodia, by means of which the organism is pushed or drawn forwards, or giving rise to a streaming forth of the protoplasm, by which the whole body seems, as it were, to flow forward in a definite direction.

There is no definite orifice for the ingestion of nutriment, which gains access to the interior of the body solely by transmission through the surface of any part of the protoplasm which may be exposed to the surrounding medium. Solid nutritious matter thus becomes pressed into the deeper parts of the body, where during assimilation it may generally be seen accumulated in pellets, surrounded by a clear liquid, and included in a single vacuole, from which the effete residue becomes afterwards expelled, and is finally ejected through any part of the exposed surface of the protoplasm. The attempt to confine the process of assimilation to the endosarc, and of contractility to the ectosarc, is not supported by careful observation. Indeed, the absence of specialisation in this most generalised phase of nutrition is further apparent from the fact that the whole process may take place even in a pseudopodium.

As may be expected in organisms of such extremely simple structure, and with the functions of nutrition and irritability showing such little tendency to specialisation, there is a corresponding simplicity in the function of reproduction. This, indeed, is probably limited to a simple division of the body referable to the established laws of cell multiplication; for the assumption that the nucleus exercises a sexual function, though insisted on by some observers, does not rest on a sufficient number of continuous and connected observations.

In many cases, however, an encysting process becomes introduced into this simple form of reproduction. The organism withdraws its pseudopodia, secretes around it a membranous cyst, and passes into a resting state. Within the cyst the protoplasm divides into two or more portions, and these finally break through the walls of the cyst and become free.

In a provisional way we may divide this class into the orders of the Foraminifera, the Radiolaria, the Lobosa and the Monera.

ORDER I.—FORAMINIFERA.

In this order the protoplasmic masses are usually invested with a covering, which may be either calcareous, and is usually so, or it may be siliceous, or of minute foreign bodies glued together, or of a horny substance; and the name is given to this order from the fact that the fine delicate pseudopods get out of the covering mass through correspondingly fine foramina, or openings therein. These Foraminifera are almost without exception marine forms, being found in the seas of all climates, though they abound mostly in the tropical seas. They live on the ocean's surface, and drop to the bottom when dead. Professor Williamson, who has written a very beautifully illustrated work on the British species, says, "Little to be envied is the man whose eye rests without interest upon forms so replete with elegance as are many of these microscopic atoms. Grace and beauty meet him on every hand, whilst the objects in which these attributes are displayed often suggest associations little to be anticipated in creatures so minute. Miniature and fairy-like representatives of the classic Nautilus present themselves in rich abundance. The Attic Amphora and the Roman Lachrymatory are foreshadowed amongst the graceful Lagenæ; whilst some of the Cristellariæ might have been the prototypes of those ancient lamps that illuminated the hall of the Carthagenian Queen, when

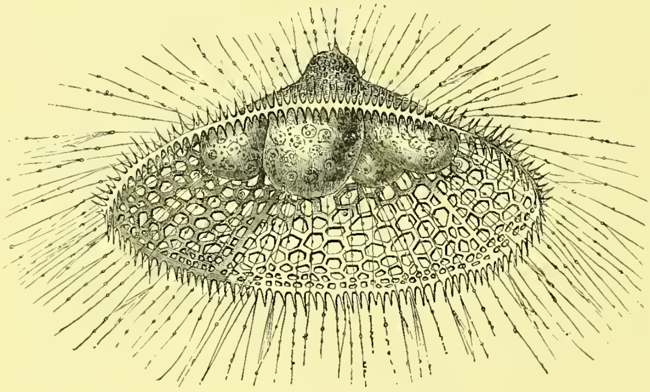
> " Dependent lychni laquearibus aureis
> Incensi, et noctem flammis funalia vincunt.

Imagination may long revel amongst these lovely creations, ever finding abundant scope for the play of fancy; and should any one still exist, in this nineteenth century, who is disposed to frown upon such objects as unworthy of serious study, let him submit to be reminded that, in nature, as well as in art,

> " A thing of beauty is a joy for ever."

ORDER II.—RADIOLARIA.

These are protoplasmic animals, often occurring in colonies, with radiating pseudopods. Their skeleton is mostly siliceous, and covered over often with a very elegant open network of silex. The lovely ornamental forms these skeletons sometimes assume may be judged of by the accompanying figure. The Radiolaria are found floating on all seas. They are exclusively marine forms; and in Haeckel's great work on the Radiolaria may be seen most beauteous figures of many of the species found in the Mediterranean.



EUCECRYPHALUS SCHULTZEI.

Professor Mivart tells us, " Under the name Radiolaria are comprised a great number of minute, very varied, and beautiful organisms, which are found swimming near the surface of the water, and which considerably resemble the Heliozoa, but are of more complex structure.

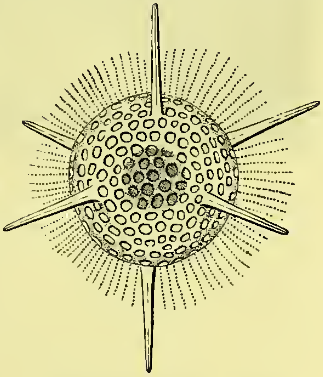
" Each individual consists of two portions of coloured or colourless sarcode, one portion nucleated and central, the other portion peripheral and almost always containing certain yellow cells. These two portions are separated by a porous membrane called the capsule; and the whole is invested by a generally very delicate gelatinous layer. The sarcode, moreover, sends forth, mostly on all sides, multitudinous radiating filamentary prolongations of its substance, the pseudopodia, which may or may not branch or anastomose. In most species skeletal structures are developed in the sarcode either outside or inside the capsule, or both without and within it, and generally in the form of spheroidal investing networks, or of radiating spines, or of combinations of these, though sometimes reduced to a few filamentary or branched spicula. Whatever its form, the skeleton is almost always siliceous, and is never calcareous. The individuals (or zooids) of some species, both of kinds provided with and others destitute of skeletal structures, naturally cohere in compound masses or colonies which may assume various shapes—cylindrical, spheroidal, or like a chain, or even a circlet of beads. There may be many more than a thousand zooids in such aggregations, which may attain a length of fifty millims. In colonies, the gelatinous investment attains a greater size than in most of the solitary forms."

" The name 'Radiolaria' was first used by the great John Müller, who in 1858 united together, under the designation, the three groups known as Polycystina, Thalassicolla, and Acanthometra. The first Radiolaria noticed were more or less indistinctly referred to in investigations as to the causes of marine luminosity by Tilesius, Baird, and Ehrenberg.

Two definite species, one simple and one compound .(Physematium and Sphœrozoum), were distinctly indicated by F. Meyer as early as 1834. A great number of fossil kinds were subsequently made known by Ehrenberg, which he assembled together under the name Polycystina, and to these living forms were subsequently aggregated.

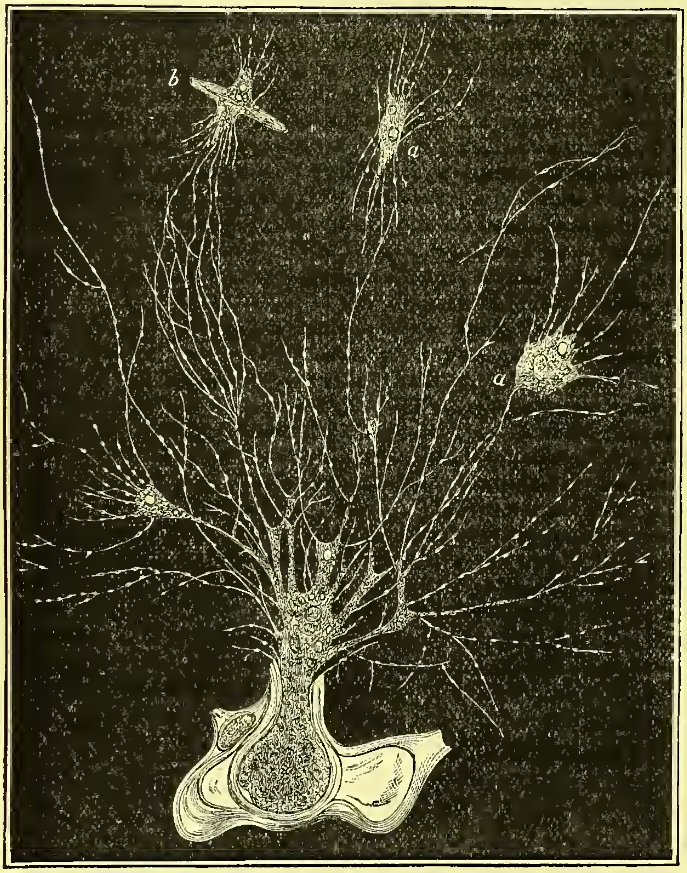
"Professor Huxley, while on board H.M.S. *Rattlesnake*, discovered certain marine organisms, to which he gave the generic name Thalassicolla; and his description in 1851 first made known the main points in Radiolarian anatomy. In 1855 John Müller described certain star-like organisms, to which he gave the name Acanthometra, and subsequently (as before said) united them with other groups as Radiolaria in a memoir which is the first great work on the anatomy of both the hard and soft parts of these organisms. In 1862 Professor Haeckel published his magnificent and classical work, 'Die Radiolarien,' containing not only the most complete account of the structure of the whole group, but copious references to all preceding writers, as well as a description of a multitude of new genera and species, with an atlas of thirty-five beautiful folio plates drawn by himself. Had this illustrious naturalist done no other scientific work, this alone would suffice to procure him enduring fame. Since this epoch-making work there have appeared other papers by the same author, describing new genera and species, and also many papers by Dana, Schneider, Wallich, Stuart, Wagner, Focke, Greef, Archer, Macdonald, Donitz, Cienkowski, Hertwig and Lesser, and Hertwig. It suffices here to make special mention of Cienkowski's researches on the reproduction of Radiolarians, and of Dr. Richard Hertwig's admirable paper on the same subject, and on the anatomy of certain forms.

"The individual Radiolarians, or zooids, vary in size from about $\frac{1}{600}''$ to $\frac{1}{20}''$; but they are for the most part invisible to the naked eye, though rarely, as in Myxobrachia (an elongated form), they may attain the length of fourteen millims. Mostly spheroidal, they may yet be conical, .cylindrical, lens-shaped, or in the form of flattened discs, and such discs may be here and there enlarged by having wide, arm-like productions The sarcode is a homogeneous protoplasmic substance containing granules. A chitinous membrane divides it, as before said, into an intra and an extra-capsular sarcode, these parts being directly continuous through minute pores which perforate the membranous capsule. The sarcode may be extremely fluid, as in Collosphæra, or relatively firm, as in Acanthometra. In most solitary forms the capsule is very large relatively to the whole mass, the extra-capsular sarcode being relatively scanty. In some forms, however, the reverse is so much the case that the diameter of the capsule may be about one-fifth of the whole organism, as is the case in Thalassicolla. In the compound forms (colonies) the capsules appear as small spheres scattered through the relatively large mass of extra-capsular sarcode and gelatinous investment. The size of the capsule may vary from about two millims (Thalassolampe and Physematium) to 0·025 millims (Zygostephanus). It is formed of a relatively strong membrane, perforated by very numerous minute apertures or pores, and sometimes marked by lines dividing its surface into irregular polygonal segments, as in Thalassicolla. Its shape is mostly spheroidal; but this may vary with the shape of the entire organism. It may also be vertically elongated, with terminal or median enlargements, or both; or (as in some Cyrtida) it may have the form of a cone, with its base provided with three or four rounded processes.


HALIOMANA HEXACANTHUM.

"The Radiolaria have as yet been found in salt water only, but there very abundantly close to the surface of the sea and at a little depth beneath the surface, whence they descend in cool or cloudy weather. Until quite recently there was no evidence that they also inhabit the deeper parts of the ocean. Haeckel, when off the coast of Sicily, found them disappear from the surface after much disturbance of the water by wind, after prolonged rain (though they do not seem much disturbed by a small quantity of it), or after many days of the sirocco. They seem to be particularly intolerant of dirty water, and delight in a smooth sea and pure transparent water at a moderately warm temperature. The voyage of the *Challenger*, however, has convinced Sir C. Wyville Thomson that though Foraminifera are apparently confined to a comparatively superficial stratum, the Radiolarians exist at all depths; and he tells us, 'In the deposit at the bottom, species occur which have been detected neither on the surface nor at a thousand fathoms, the greatest depth at which the tow-net has been systematically used; and specimens taken from near the surface give us the impression of being generally larger and better developed.'"

"As to their geographical distribution, the same author tells us, 'Radiolarians were met with throughout the whole of the Atlantic, and often in great abundance, the sea being not unfrequently slightly discoloured by them. The forms which appeared in such numbers were usually species of the Acanthometridæ, but Polycystina and the compound genera were also numerous. The remains of Radiolarians were found in all deep sea deposits, usually in very direct proportion to the numbers occurring on the surface and in intermediate water. It was frequently observed, however, that when, in deep water, certain species swarmed on the surface, very few of their skeletons could be detected at the bottom.'"



CHLAMYDOMYXA LABYRINTHULOIDES. (*Archer.*)

ORDER III.—LOBOSA.

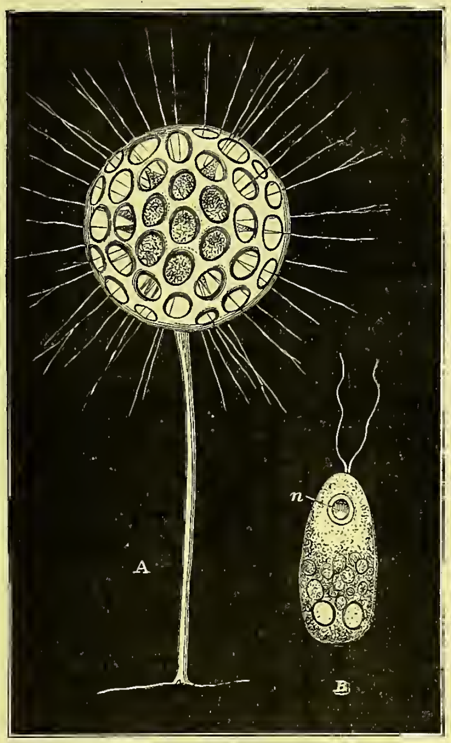
Although some of the species placed here are marine, yet most of them are fresh-water organisms of very minute size. Some of them have no covering to their soft bodies; others have the outer portion of their protoplasm firmer than the inner; others even form a coating over them of minute grains of silex; some have even a skeleton, through which the pseudopods are protruded. We give an account of two forms, one of which my friend W. Archer, of Dublin, has described, with excellent figures. It is a very remarkable organism, which in many respects possesses intimate relations with Cienkowski's Labyrinthulea. It was found in fresh water, and is named Chlamydomyxa labyrinthuloides.

It has a soft sarcodic body, surrounded by an outer tough cyst, which is of a very irregular outline, is composed of many layers, and shows distinct cellulose reaction.

The sarcode contents are composed of a basic hyaline substance, in which are immersed various kinds of granules. Among these are certain homogeneous rounded corpuscles of a pale bluish tint, which take an important part in the vital phenomena of the organism. Notwithstanding the toughness of the cyst, the contents can burst their way through it, and the protoplasm then pours forth, carrying with it its imbedded granules, and spreading itself out over the field of the microscope. It now shows a beautiful play of very numerous globular pulsatile vacuoles.

The first part of the protoplasm which issues from the cyst forms a main trunk, which soon subdivides into branches, from which others are emitted; and in a short time we see a complex system of ramifications extending far and wide, and formed by hyaline, quite colourless threads of extreme tenuity.

At the same time there appear in these threads minute fusiform bodies of a pale bluish colour, which may be seen to be in constant motion along them. They are identical with the round bluish granules of the central mass, and it is only on leaving this to wander along the filaments that they assume the fusiform shape.



CLATHRULINA ELEGANS.

Another is Clathrulina elegans, originally described by Cienkowski, who discovered it near St. Petersburg. Greeff also gives a very full description of this beautiful little Rhizopod, which he obtained in the neighbourhood of Bonn. It had been found by Haeckel near Jena, while a closely-allied, if not identical, form had nearly simultaneously with Cienkowski's discovery been observed by Archer and others in Ireland and Wales.

It occurs chiefly in dark ponds shaded by trees and containing decaying leaves. Its soft, sarcode body is included in a silicious capsule of a spherical form, regularly perforated in the manner of lattice-work, and supported on a long silicious peduncle.

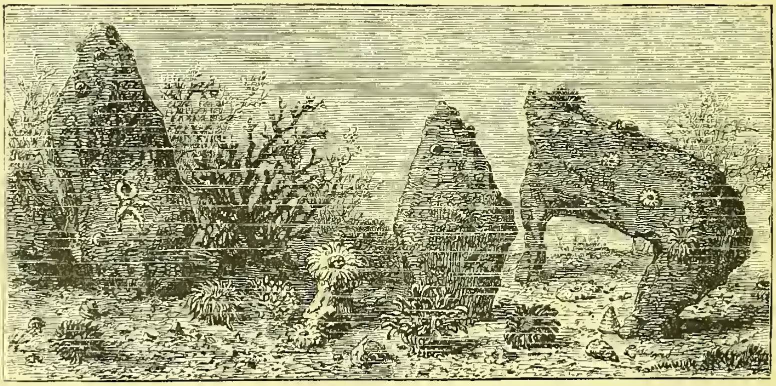
Pseudopodia are projected through the lattice-work of the capsule; and these, as in the Actinophryidæ, are composed of an axis substance and a cortical substance. The axis has been followed into the interior of the protoplasm; vacuoles which hold no stable position are scattered through the protoplasm; and there is a vesicle-like nucleus, which is rendered evident by the application of acetic acid.

ORDER IV.—MONERA.

Professor Haeckel tells us, "I have called those forms of life, standing at the lowest grade of organisation, Monera. Their whole body, in a fully-developed and freely-moving condition, consists of an entirely homogeneous and structureless substance, a living particle of albumen, capable of nourishment and reproduction. These simplest and most imperfect of all organisms are, in many respects, of the highest interest. For the albumen-like, organic matter meets us here as the material substratum of all life-phenomena, apparently not only under the simplest form as yet actually observed, but also under the simplest form which can well be imagined. Simpler and more incomplete organisms than the Monera cannot be conceived.

"Indeed, the whole body of the Monera, however strange this may sound, represents nothing more than a single, thoroughly homogeneous particle of albumen, in a firmly adhesive condition. The external form is quite irregular, continually changing; globularly contracted when at rest. Our sharpest discrimination can detect no trace of an internal structure, or of a formation from dissimilar parts. As the homogeneous, albuminous mass of the body of the Moner does not even exhibit a differentiation into an inner nucleus and an outer plasma, and as, moreover, the whole body consists of a homogeneous plasma, or protoplasma, the organic matter here does not even reach the importance of the simplest cell. It remains in the lowest imaginable grade of organic individuality, as that of one of the simplest of these animals.

"The first Moner whose natural history was fully investigated, was Protogenes primordialis, which I observed, in the spring of 1864, in the Mediterranean, off Nice. When swimming freely in the sea-water, this Moner looks like a transparent, globular particle of mucus, of about one millimetre in diameter (smaller specimens measure only 0.1 mm. in diameter). Only about a third of this measurement applies to the inner central portion of the body, the homogeneous solid sarcode ball, while the outer two-thirds consist entirely of thousands of fine, radiating, mucous threads. These threads, the so-called pseudopods, some of which run simple, and some twisted and anastomosed to the periphery, radiate immediately from the periphery of the central albuminous body. They show throughout the same life-phenomena as the similar sarcode threads of the true Rhizopoda (Acyttaria and Radiolaria). The solidified, albuminous mass of the whole body was in continual motion, now slower, now faster, which was easy to follow by the passive movements of the fine and usually numerous particles scattered in the albuminous mass. The sarcode threads constantly varied in number, form, and size; they ramified and anastomosed, separated again, and were drawn back into the central principal mass. In short they exhibit exactly the same appearance which has been so often and so fully described by Max Schultze in the Polythalamia, and by myself in the Radiolaria. Nourishment was also taken by the Protogenes, in the same manner as by the last-named, true Rhizopoda. Smaller bodies (Diatomaceæ, unicellular Algæ, &c.) remained hanging on the glutinous surface of the albumen threads if they accidentally came in contact with them, they were surrounded by them, and then slowly drawn into the central albuminous mass. Large bodies, such as, for example, Peridinium, were finally entirely surrounded by the body of the Protogenes; afterwards, certain contents of the victim were first assimilated; and the Protogenes then immediately moved away from the indigestible shell. In a shallow watch-glass, with a little sea-water left standing for some time, the Protogenes spread itself out at the bottom in the form of a thin, hyaline, mucilaginous plate. This plate had a very irregular jagged outline, and a diameter of from three to four millimetres. But the most important point which I could ascertain respecting the Protogenes was its reproduction by spontaneous fission. This was accomplished by a simple division of the globular, mucilaginous body into two halves, without this being preceded by a special motionless or encysted condition, &c."



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